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ABSTRACT

This teaching guide and syllabus outline is intended for use with pupils whose primary interests are in non-science fields, or who do not intend to enter college. The guide contains suggested activities, both laboratory and discussion, for a course containing the following sections: Introduction to Cells and Life; Animal Physiology; Plant Physiology; Reproduction and Development; Genetics; The History of Life; and Ecology. Activities are accompanied by a statement of the intended objectives and understandings, a list of materials needed, key words, and, in some cases, a series of questions for consideration. Emphasis throughout is intended to be on the relationship of the topics chosen to the pupils' needs, interests, activities, and occupational objectives. (AL)

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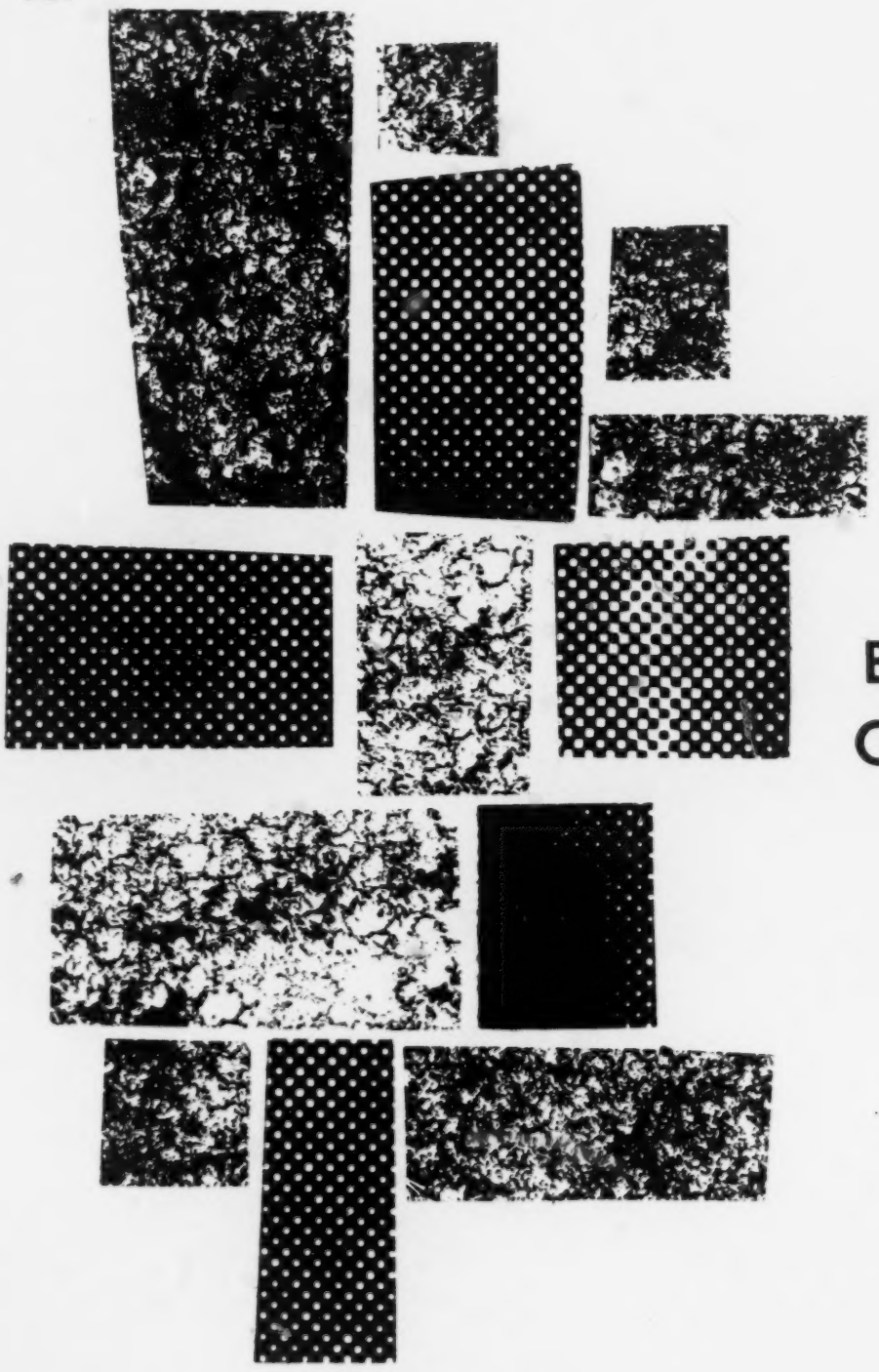
SCIENCE CURRICULUM MATERIALS



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BIOLOGY
GRADE 10

1970

SE 012 044

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SCIENCE

BIOLOGY 10

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DIVISION OF INSTRUCTION
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ACKNOWLEDGMENT

This Biology 10 curriculum guide is one in a series of science guides developed by the Division of Instruction to provide for the pupil whose primary interests are in non science fields, whose interests and goals are closely allied to the objectives of general education.

The emphasis in Biology 10 is to provide each student with a general knowledge of how living things live, survive, and reproduce in the natural environment with man as the central theme. Plants and other animals are included as they relate to man. Without becoming too technical, the teaching in Biology 10 involves the development of an appreciation for the beauty and organization of life, and for the values of scientific methods.

Emphasis throughout this biology course is placed on teacher flexibility in selecting, modifying and using this guide as determined by appropriate classroom interests. Emphasis is given to laboratory activities from which most of the understandings should develop. These laboratory activities also serve to develop an appreciation of scientific methods and to increase the ability and willingness of each student to change beliefs and opinions on the basis of objective evidence. These attributes are among the desirable outcomes of this biology course.

Material changes in content and sequence from the 1963 Life Science 10 curriculum guide were suggested by teachers and department heads during the 1968-69 and 1969-70 school years. These suggestions were reviewed and revised by Miss Eleanor F. Nunn, East High School, and Mr. Joseph D. Abernethy, John Marshall High School, both experienced biology teachers. Dr. Samuel W. Bloom, director of Science, edited and prepared the final manuscript for publication.

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Summer - 1970

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FOREWORD

The educational program for the high schools recognizes that the pupil population comprises individuals whose interests, objectives and occupational goals vary. The ideal curriculum would provide programs of study tailored to each student. This course of study, while far from meeting this ideal, provides extensive teacher flexibility in the selection of content, sequence and methods so that the needs and interests of the pupil are more nearly met.

Biology 10, in addition, is designed to serve both the student whose formal education is terminal at the conclusion of secondary school and the student planning further education but whose primary interests are in fields not directly related to science. This program of studies in biology is mainly for the student whose interests and goals are generalized rather than specific.

The units of Biology 10 combine two components: one, a revision of the Life Science 10 syllabus of 1963; two, a modification and incorporation of the State Experimental Syllabus in General Biology, 1969. The emphasis in this course of study is to provide pupils with useful applications of biology in everyday living with man as the central theme. The pupil as a living organism functions in a natural world. It is essential that he become aware of the interrelationships of man to other living things, plants and animals, and of their combined effect upon the biosphere.

Biology 10 has intellectual content. Technical subject matter is not omitted or minimized, the direction is changed. It is expected that the emphasis generally placed on the traditional academic type of preparation would increasingly be shifted by the teacher from the technical aspects to the general education of the learner and its immediate usefulness to him. Increased learnings will occur as the concepts and activities are related to the pupils' interests and goals with many classroom activities provided for individuals and small groups.

MESSAGE TO TEACHERS

This Biology 10 curriculum guide has been revised in terms of classroom needs. The regular Regents program in Biology nor the State Experimental Syllabus in General Biology is suitable for students whose goals, interests and objectives are in areas other than science. Yet, it is desirable and quite essential that the non science major become familiar with the basic concepts and understandings inherent in the biological sciences. Students, as individuals and as members of society, should have functional knowledge of their immediate environment in terms of fundamental basic biological principles. These principles and understandings should be related to the pupils' needs, interests, activities, daily experiences, and future occupational objectives.

Teacher Flexibility

As a teacher, you have latitude and flexibility in developing your program in Biology 10. This printed course of study should be considered only as a guide; it is not a series of lesson plans. It is the expectation of the curriculum committee that the basic concepts and understandings listed will be covered through the year. However, feel free to change, delete or modify the pupils' experiences and activities as determined by the class or by individual students.

Laboratory Orientation

This is a laboratory oriented program. Plan to provide as many different student activities as possible. Teacher demonstrations should be kept to a minimum with individual pupils or small groups performing the exercises for the larger group. The biology classroom and laboratory should be considered a workshop area with many specimens, living and preserved, with student stations available for individual project work.

The units and laboratory exercises contained in this biology guide are designed on a five time a week basis for an entire school year.

Mathematical Computations

Mathematical computations should be kept at a minimum and used only as a tool to develop understandings. When mathematical manipulations are needed, teach the class the fundamentals. Do not assume that every class member can manipulate numbers or relate to arithmetical concepts. Avoid any manipulations more complex than a simple ratio, two or three number multiplication or division, and the construction of graphs along the positive x-y quadrant.

Relevancy

Illustrations, sample activities, field trips, laboratory experiences, classroom discussions should be related closely to the everyday activities, interests and environment of the individual. Draw biological analogies, examples and illustrations from the immediate neighborhood of the school and the home. Get pupils interested in their immediate environment to which they can relate through knowledge and familiarity. Teachers should not hesitate to alter the prepared lesson of the day if the interests of the class indicate a change of emphasis.

Each Student is a Consumer

A skillful teacher will develop his program about the needs of individual class members. Utilize basic biological and health principles to the consumer interest and well-being of the pupil and the class. Consumer activities listed are some of the legitimate concerns of the biology class, there are many more which you, as a teacher, can bring to the attention of the class:

Action of enzymes in soap on the skin

Presence of preservatives in food

Frequency and kinds of food adulterants

Biological effects of pesticides

Abuse of over-the-counter drugs and drug products

Dubious health aids

Value of the so-called "health" foods

Reducing diets and proprietary preparations

Reading Skills

Teachers cannot assume that students entering a Biology 10 class are reading at the tenth grade level of comprehension. The facts are different. In an average high school classroom, teachers find a reading range from the fourth grade level to eleventh or higher levels. Anticipate lower reading levels for pupils enrolling in Biology 10 and be prepared to deal with poor readers. Moreover, readings and reading skills in biology are unique to the subject and pupils must be taught how to read the biology textbook, how to follow instructions, how to study biology. Biology has a special, technical vocabulary which must be understood before the concepts can be comprehended. On the other hand, undue emphasis on a technical vocabulary is unnecessary, frightens pupils, and should be avoided.

Many of the problems of reading biology materials are common problems in all the content fields. These problems appear exaggerated in biology due to the specialized vocabulary. If a teacher is to be successful teaching the concepts in biology, he must also be a reading teacher and teach pupils how to approach readings in biology. Five steps should be considered in a reading lesson:

a. developing reading readiness
b. the initial reading of the material
c. developing word recognition skills
d. discussion and rereading
e. follow-up activities related to the reading

Ways of Meeting Problems in Reading Biology Materials

A. Difficulties of Vocabulary

A biology textbook contains a considerable vocabulary of scientific words in addition to the basal vocabulary and these words should be taught and understood. It is important that the teacher anticipate vocabulary difficulties and to de-emphasize the use of technical terminology. Vocabulary difficulties are, perhaps, the chief cause for the lack of a pupil's success in biology.

Most biology textbooks have some means of calling the attention of the pupil to a technical world when it is first introduced: bold-face or italicized type. Teach pupils how to recognize new terms, how to use a glossary, and how to make these terms part of their basic background for future readings.

Although it is helpful for students to be familiar with scientific terminology, the emphasis in Biology 10 is upon understandings. Whenever possible, translate scientific jargon into everyday language which has meaning to the individual student. Key Words listed in the guide are for teacher guidance and not the basis for pupil assignments.

B. Difficulties of Concepts

Explanation of scientific experiments that can be observed by the pupil are often difficult. Some students accept what they observe without trying to understand the explanation. Others will try to understand but need help, while still others will perform experiments and will read and understand the explanation without help. Each of these groups need a different means of instruction. Diagrams, similes and every aid possible should be used to make clear those concepts that cannot be made clear by experiments. Guided discussions often aid in clarifying contents.

C. Difficulties Due to Following Reading Related to Diagrams

Many diagrams are found in science material. In order to understand the discussion, the diagram must be read and interpreted. Some pupils find reading diagrams difficult because they do not connect the discussion of a diagram to the diagram itself. The teacher can often help the student who is in difficulty by showing him that pictured in the diagram are facts that have come within his experience. The teacher will need to give direct teaching in reading diagrams, beginning with very simple concrete illustrations and proceeding to more abstract generalized ones.

D. Difficulties Due to Need to Follow Directions

In biology, many experiments are performed which make it necessary for the student to read to follow directions. These directions should be read slowly and thoughtfully so that the experiment may be followed step by step in the proper order. Specific training will be needed. As the student reads directions and does experiements, the teacher should detect any difficulty the pupil may be having and give added instruction.

E. Difficulties in Seeing Relationships and Formulating Generalizations

Seeing relationships and forming generalizations may be difficult for some pupils. They will need many opportunities to consider relationships in order to reach conclusions or generalizations.

The rate of reading biology materials needs to be slower than the rate at which pupils read in other content areas. It is important to help students adjust their rate of reading to the purpose at hand.

F. Difficulties in Differentiating Facts from Opinions

Students' reading experiences in biology should be guided toward developing abilities to differentiate between fact and opinion in their reading; to recognize the difference between books written for entertainment and those which are sources of accurate science information; to learn the importance of copyright dates and authors in determining whether reading materials are authentic or not; to question the accuracy of what appears in print; and to check conflicting statements with other reliable sources.

Skill in reading biology materials needs to be developed. Teachers have the responsibility of teaching pupils to read biology materials, meaningfully.

Textbooks and Multimedia Instructional Materials

Finding a suitable textbook for Biology 10 is a difficult task. The reading levels of many biology textbooks together with the excessive technical vocabularies are beyond the range of most biology students except the more able. There is no one textbook currently available that combines the concepts to be learned at a reading level that can be easily comprehended. Moreover, teachers will find that it is unlikely that any single textbook follows the city or the state course outline. Teachers should plan, therefore, to use multiple textbooks written for different reading levels; films; filmstrips; single concept films; tapes; and other instructional media in developing their day-to-day series of activities.

Appropriate instructional materials are available from the Educational Communications Department. A film catalog listing current films in science is available in each school. A special listing of science films is prepared for each teacher early in the school year. Be certain to obtain your copy. New science films are continually being added to the film library. As new films are received, schools are notified. Similarly, special programed learning materials are available for individual pupil use. A list of such materials may be obtained from the Programed Learning Office, 410 Alexander Street.

Although teachers are generally limited to the use of biology textbooks available at their school, they have greater choices in the selection of the expendable laboratory manuals or workbooks. Laboratory manuals are revised frequently and purchased annually by the school or pupils with teachers directly involved in the selection process.

Select the laboratory guides which more nearly meet the requirements of your class. You may, even, wish to use several different workbooks in the same classroom; this is your option. In the selection of workbooks, be especially sensitive to reading levels, kinds and quantity of activities, appropriateness of concepts, et cetera. Avoid any laboratory workbook which is wordy, with an overload on technical terms, with a limited number of pupil activities, and which is remote from the objectives of the Biology 10 program.

SUGGESTED TIME SEQUENCE

UNIT		NUMBER OF DAYS
I.	Introduction	20
II.	Animal Physiology	50
	Functions (30)	
	Behavior (10)	
	Disease (5)	
	Tobacco, Alcohol, Drugs (5)	
III.	Plant Physiology	10
IV.	Reproduction and Development	20
V.	Genetics	16
VI.	The History of Life	10
VII.	Ecology	30
	Total	156

UNIT I - INTRODUCTION

I. Life

- A. Definition
- B. Activities

II. The Cell

- A. Microscope
- B. Cell structures

III. Classification of Organisms

REFERENCE OUTLINE

I. Life

A. Definition

OBJECTIVES AND UNDERSTANDINGS

To realize that definitions of life must be stated in terms of the activities of living organisms.

To define the activities of living organisms in terms of life processes.

MATERIALS

petri dish
drop of mercury
dilute nitric acid
potassium dichromate
iron nail

ACTIVITIES

Demonstrate Mercury Ameba. "Is it alive?"

Put a drop of mercury in a petri dish. Cover the mercury completely with dilute nitric acid. Add a few potassium dichromate crystals. Insert the tip of an iron nail into the mercury. Slowly add more acid. Use the overhead projection for this demonstration. It is more effective if the students do not know the materials before the discussion. (Caution: Toxic Chemicals.)

Discuss "What is Death?" - (organ transplants)

KEY WORDS

life
death
living organism

REFERENCE OUTLINE

B. Activities

OBJECTIVES AND UNDERSTANDINGS

To list the basic life activities of all living things.

getting food (related to nutrition)

breathing (related to respiration)

moving (motion)

getting rid of wastes (excretion)

reacting to internal and external changes (behavior)

manufacturing substances (synthesis)

growing (growth)

reproducing (reproduction)

To identify that living things show great diversity.

To learn to make skillful, scientific observations.

MATERIALS

ACTIVITIES

"What kinds of activities do all living things carry out?"

Use as many live plants and animals as possible to illustrate and stimulate this discussion.

*BSCS Green Version, Investigation 1.1 is an excellent start for beginning biology students. It teaches pupils how to observe living things scientifically.

A wide variety of living organisms should be used in this investigation.

KEY WORDS

life activities

*References to the BSCS Green Version made throughout this course of study refers to: BSCS Green Version, High School Biology, 2nd Edition. Chicago: Rand McNally & Company, 1968.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
II. The Cell	To be able to recognize that all living things are composed of one or more cells. To discover the importance of cell specialization.
A. Microscope	To be able to demonstrate skill in the proper use of the microscope. The microscope is the basic tool used in biology for acquiring new information.
B. Cell Structures	To recognize some of the cell structures and their functions.

MATERIALS

microscope

ACTIVITIES

This activity introduces students to the use of the microscope. The teacher should demonstrate how to carry and position the microscope. Any activity on the use of the microscope may be used. It is important to stress the proper use of the microscope. This skill, once acquired, will serve the students well throughout the rest of the course.

Observation of plant and animal cell structures

cork
slides
cover slips
dropper
microscope

Procedure:

A. Cork cells: Carefully use a single-edged razor blade to cut a thin slice from a piece of cork. The sliver has to be so thin that you can see through it. When you have a suitable thin section of cork, put it on a clean slide in a small drop of water and carefully cover with a cover slip. Observe the specimen under the low power of the microscope. Look along the thinnest edges of the cork.

Draw a picture of what you see with low and high power.

The following activities will enable the student to observe various cells. Since stains will be used, mention that stains are dyes and they will do just that when spilled on clothing. Stains enable structures to be viewed more clearly.

microscope
onion skins
Lugol's iodine ($KI-I_2$)

Gentian violet
slides
cover slips
forceps

B. Onion skin cells: Cut open an onion and break one of the layers. With forceps or (finger nails) peel off a piece of the thin skin or epidermis. Cut two 1/4 inch sections. Mount one in Lugol's iodine solution, the other in Gentian violet stain. Examine both with the microscope. What evidence do you see of a nucleus? cytoplasm? cell wall? vacuole? Compare onion skin cells and cork cells. LABEL the onion skin drawing.

KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To compare the similarities and differences between plant and animal cells.

Cell Structures
1. Cell membrane
2. Cytoplasm
3. Nucleus
4. Chromosome
5. Cell wall (plant)
6. Chloroplast (plant)
7. Vacuole

Cell Organization
1. Tissues
2. Organ
3. System
4. Organism

MATERIALS

ACTIVITIES

microscope
elodea leaf
slides
cover slips

Select a leaf from the tip of an elodea plant and put it on a clean slide. Add a drop of water and cover with a cover slip. Observe with low power and then with high power. What are the green bodies? What causes movement within the cell? Diagram what you observed with high power.

microscope
toothpicks
slides
cover slips
methylene blue

Observing cheek cells. Place a drop of water on a clean slide. With the broad end of a toothpick gently scrape the inside of your cheek and deposit a little of the scraping in the drop of water. Mix thoroughly until the water turns milky. Now add a drop of methylene blue or iodine and cover the material with a cover slip. Your preparation contains cheek cells (mucus epithelium cells).

Find a single, isolated, flattened cell under high power. Observe carefully and locate the nucleus, cytoplasm, and cell membrane. Make a labeled diagram of a single cheek cell as viewed under high power. What common structures occur in the cells you observed? What specialized adaptations did you see in other cells? What is the advantage of staining cells for microscopic study?

KEY WORDS

REFERENCE OUTLINE

III. Classification

OBJECTIVES AND UNDERSTANDINGS

To learn how to classify a diversity of organisms into groupings.

1. Man attempts to group things in ways that make sense.
2. Groups are based upon observation and experience.
3. Things are placed in similar groups according to important likenesses.
4. Grouping brings out relationships.
5. It makes the study of living things more understandable.

MATERIALS

ACTIVITIES

Most classes will need basic orientation to the concept of classification. You might start with shopping lists of many varied items to be reorganized by the class into groups.

Different types of "pins" may be listed on the board by students and then grouped in various ways.

Objects which can actually be handled by students are even better, such as packages of assorted fasteners (screws, nuts, bolts, etc.) which can be put into groups by small teams. (At this point it might be wise to ask for groups based on form not function.)

construction paper

Geometric forms cut out of construction paper may be grouped by small teams of students.

*For other basic activities on grouping, see BSCS Biological Science: Patterns and Processes, pages 1-9 and 14-18.

KEY WORDS

classification

*References to Patterns and Processes throughout this course of study refers to BSCS Biological Science: Patterns and Processes, Teacher's Handbook. New York: Holt, Rinehart and Winston, 1966.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Teacher's Note:
No attempt should be made to teach a course in taxonomy to 10th grade general biology students. There is no need for memorization of phylum names and characteristics. An understanding of the principle of classification, the classification scheme and an ability to use simple keys and reference works is all that is required.

To be able to write the names and the need for three kingdoms.

To classify common vertebrates:

kingdom, phylum, class

To classify man as follows:

Kingdom:	Animal
Phylum:	Chordate
Class:	Mammal
Order:	Primate
Family:	Hominidae
Genus:	Homo
Species:	sapiens

MATERIALS

animal and plant specimens

ACTIVITIES

Recall here the problems in defining "living", then use an assorted group of living and non living things and ask the students to classify.

Review Life Activities

This can be followed with a simple observational exercise. Use an assorted group of animals. Have students compile a check list of their main characteristics.

Number game

"I am thinking of a number between one and thirty-two. What is the least number of questions you could ask to be sure of knowing the number? I will answer only yes or no." Students should see that the numbers can be eliminated in groups by asking key questions. "Is it odd?" Point - easier identification if things are put in smaller, more similar groups.

Investigation 4.2, "Structural Characteristics in the Identification of Animals", (Green Version) may be a useful exercise for some interested pupils. Recommended for independent study activity.

KEY WORDS

kingdom
phylum
class
species

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To understand that there are many important and various groups of invertebrates.

To be able to discuss the reasons for the use of scientific nomenclature.

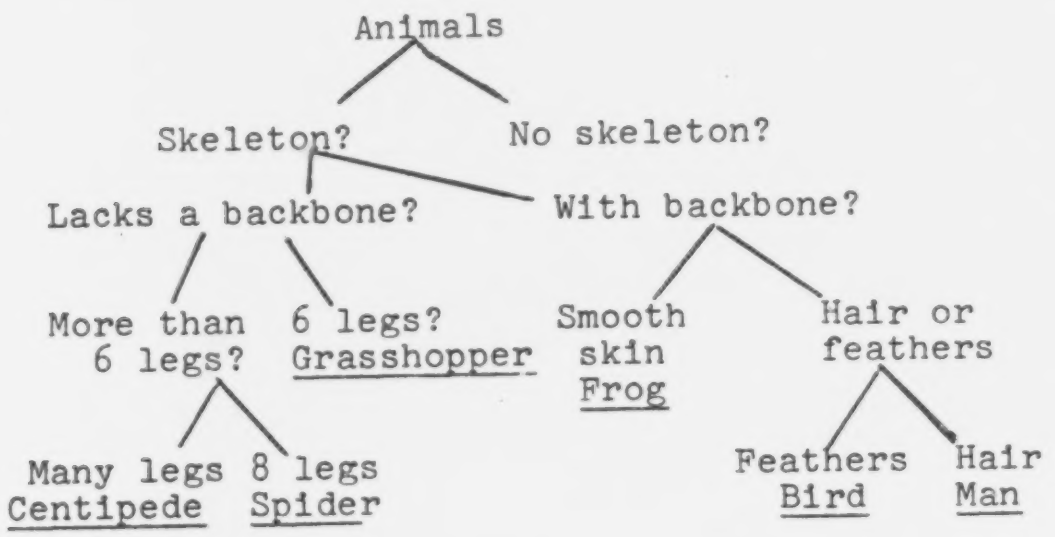
To recognize if two organisms are members of the same species based on a system of classification.

MATERIALS

grasshopper
frog
bird
spider
man
centipede
(live or illustration)

ACTIVITIES

Group these animals in the same manner as in the number game, by asking the following questions:



King, Phil, Came, Over, From Great Spain

(Ancient but useful for students)

Bring out the analogy for the address and delivery of a postal letter and the system of classification for living organisms.

KEY WORDS

UNIT II

ANIMAL PHYSIOLOGY

UNIT II ANIMAL PHYSIOLOGY

I. Functions
  A. Energy transformations
    1. Nutrition
      a. Food sources
        1) Nutrients
        2) Consumer problems
          a) Nature of the problem
          b) Biological consumer problems
          c) Economic consumer problems

      b. Ingestion

      c. Digestion

      d. Egestion

      e. Transport
        1) Absorption
        2) Circulation

    2. Respiration

  B. Excretion

  C. Regulation
    1. Systems
      a. Nervous
      b. Endocrine

    2. Behavior
      a. Mechanisms
      b. Ecological approach

II. Malfunctions
  A. Disease
    1. Causes
      a. External
      b. Internal
        1) Infectious
        2) Non-infectious

    2. Control
      a. Individual
        1) Natural
        2) Artificial
      b. Public

  B. Alcohol, Tobacco and Drugs
    1. Alcohol
    2. Tobacco
    3. Drugs

REFERENCE OUTLINE

UNIT II Animal Physiology

OBJECTIVES AND UNDERSTANDINGS

Teacher's Note: How do animals carry out their basic life activities? Avoid a detailed study of examples from each Phylum. Man will and rightfully should be the object of major interest and prime example. Other animals should also be used as examples of similar or unique ways of carrying out the life activities.

Recall that the 10th grade Biology student has probably had the 7th grade Life Science course, a health course, a knowledge of chemistry and energy from 9th grade Science and will be taking another health course.

Avoid unnecessary repetition if possible. In some areas only a brief review may be needed.

To show experimentally the transfer of mechanical energy into heat energy.

MATERIALS

4 large containers, each capable of holding 1000 ml
thermometer
ice

ACTIVITIES

1. Put enough water in each of the four beakers to cover your hand completely. This water should be about 10°C.

2. Immerse one hand in the water. Stir the water with a stirring rod, but do not move the hand that is in the water. Have your partner hold a thermometer in the water and record readings of the water temperature each minute for five minutes. Record your data.

3. Remove your hand from the first beaker at the end of five minutes and immediately put it in the second beaker. Be sure that some member of the team has prepared water so that it is at the same starting temperature. Stir the water, but do not move the hand. As before, take temperature readings each minute for five minutes. Record the readings.

4. Use your other hand for the third part of the activity. Put your hand in a third beaker of water that is at 10°C. Exercise the hand by moving the fingers rapidly in the water. Keep a record of the temperature each minute for the next five minutes.

5. Put a thermometer only (not your hand) in the fourth beaker, but be sure the water is at the starting temperature. Again, keep a record of the temperature each minute for five minutes.

6. Make a line graph of the temperature readings for each trial. You will have four lines on the same graph.

QUESTIONS

1. What was the purpose of the fourth container?
2. What happens when you put your hand in cold water?
3. Explain temperature differences between the various trials.

REFERENCE OUTLINE

I. Functions

A. Energy Transformation

OBJECTIVES AND UNDERSTANDINGS

To understand the concept of homeostasis.

Life by its nature requires energy.

The sun is the source of energy for living things.

Producers capture energy from inorganic sources: consumers must obtain their energy from producers.

MATERIALS

ACTIVITIES

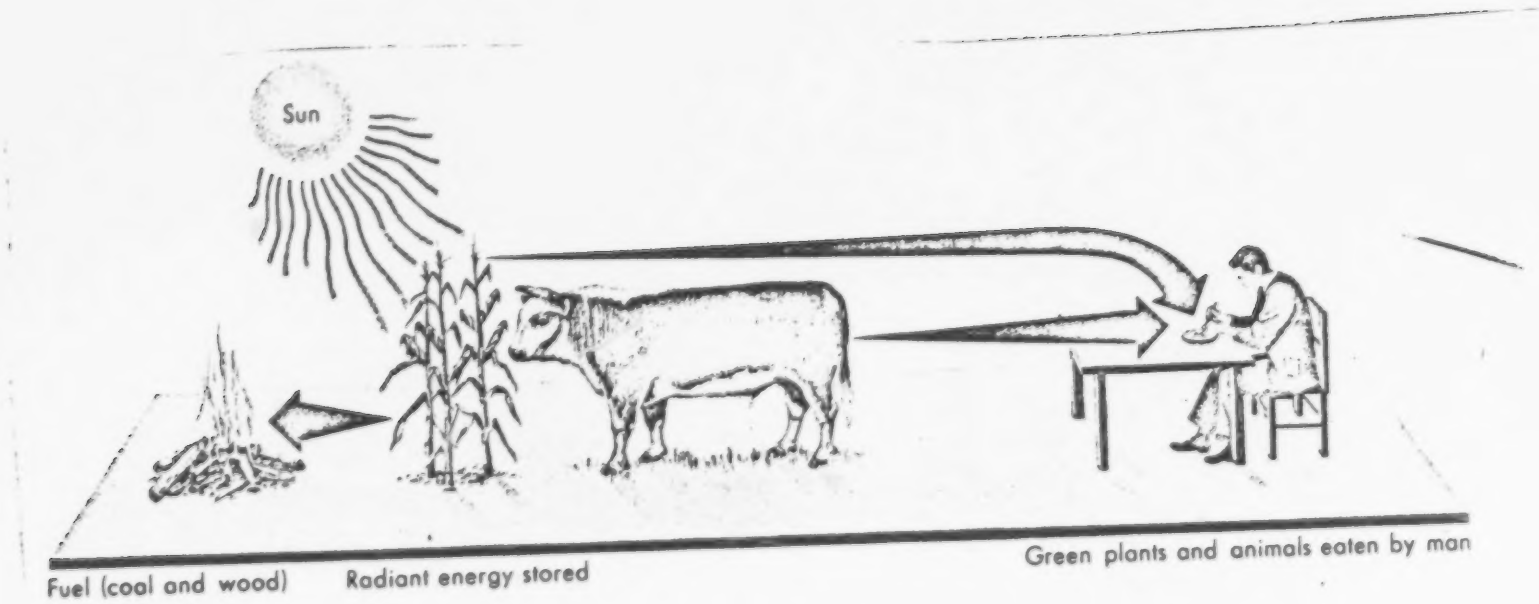
Photosynthesis will be covered in more detail under the topic of Leaf Function in Unit III.

Review concepts of energy and energy transformations from previous science courses. Stored energy is potential energy; kenetic energy is the energy of motion.

Draw a sketch on the blackboard similar to sample. From this sketch, have pupils discuss the inter-relationship of the energy and food cycle.

Key Words

producer
consumer



REFERENCE OUTLINE

1. Nutrition

OBJECTIVES AND UNDERSTANDINGS

Food is the potential source of energy. The changes to make it useable and its delivery to the cells is known as nutrition.

Food energy is measured in energy units called Calories.

MATERIALS

(For each team of two or four)

tin can
calorimeter
test tube
small cork
needle
thermometer
book of matches
10-ml graduated cylinder
3 pieces of of walnut (each weighing 0.20g)
3 pieces of peanut (each weighing 0.20g)
cellophane tape

ACTIVITIES

Purpose: To measure the energy stored in a food.

Procedure:

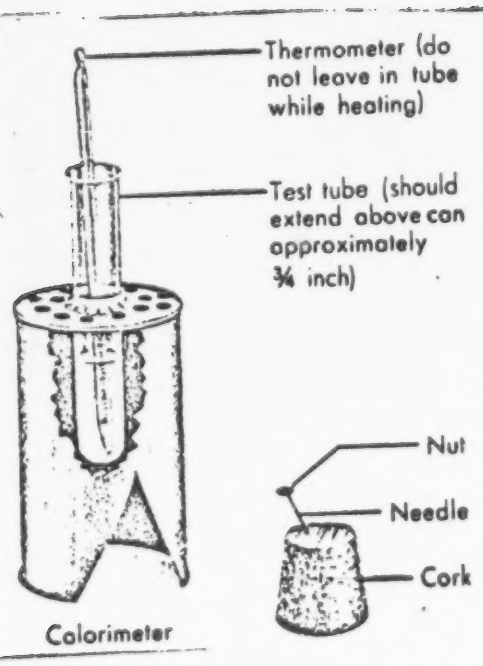
1. Assemble the equipment as shown.

2. Measure 8ml of water and put it in the test tube.

3. Measure the temperature of the water and record it on your table. Remove the thermometer before proceeding to the next step.

4. Ignite the nut and quickly put it under the test tube inside the calorimeter. Burn the nut to an ash. If the fire sputters and goes out, reignite the nut. If this problem persists, punch a few more holes - in the top of the can. This will permit more air to reach the fire to keep it burning. Discard the partially burned nut, refill the tube, and start over with a new piece. In fact, whenever in doubt, do it over. What would be the reason for this procedure?

5. After the piece of nut has burned completely, measure the temperature of the water and record it on your table. Repeat the procedure for three peices of walnut and three pieces of peanut. Average the differences. Why should you average the differences?



To calculate calories

Average difference x 8ml = No. Calories

$\frac{\text{Number of calories}}{1{,}000}$ = No. Calories (Kilocalories)

Number Calories x 5 = Calories/gram (in 2g)

Teacher: Explain why the number of Calories is multiplied by 5 in this example.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

The chemical reactions in living things are controlled by enzymes.

Enzymes help maintain homeostasis.

MATERIALS

(for each team of two)

fresh 3% hydrogen peroxide solution
2 small test tubes
forceps
test-tube holder
fresh liver and raw potato
wax marking pencil
bunsen burner
mortar and pestle
fine sand
manganese dioxide powder
splints and matches (optional)
metric ruler

Key Words

enzyme
homeostasis

ACTIVITIES

Purpose: To observe the action of a catalyst.

Procedure:

1. Measure and mark two test tubes with the wax marking pencil about 2 cm from the bottom. Into each test tube pour some hydrogen peroxide solution up to the mark.
2. Into one of the test tubes sprinkle a pinch of fine sand. Note the result, if any.
3. Into the second test tube sprinkle about the same amount of manganese dioxide powder. Note the result, if any.
4. Clean out your test tubes and pour fresh hydrogen peroxide solution up to the 2-cm mark. Using your forceps, select a small piece of liver and drop it into the test tube of hydrogen peroxide. Observe for a few minutes and record the results.
5. Now take a piece of liver about the same size as the one you used before, and put it in a mortar along with a pinch of fine sand. Grind the liver, and then transfer the ground material (along with the sand, which will not interfere with the reaction) to a test tube containing fresh hydrogen peroxide solution. Note how the activity of the ground liver compares with the activity observed for the whole piece of liver.
6. Finally, take another piece of liver and put it in boiling water for a few minutes. Then drop the piece of boiled liver into a clean test tube containing hydrogen peroxide and observe what happens.
7. If time permits, repeat these tests using raw potato.
8. Fill in the table to indicate the different strengths of activity (different reaction rates). Use high, medium, low, and no reaction to tindicate the various reaction rates.

Do all living things contain catalysts? How might you determine the probable answer to this question?

Discuss the role of enzymes in living things.

Expected Results

	Liver	Potato
Whole	Medium	Medium
Ground	High	High
Boiled	Low	Low

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
a. Food Sources	
1) Basic Nutrient	Students should be able to list the food nutrients; their uses by living cells, and the simplest form of each.
	a. Carbohydrates -for energy and stored energy-simplest form-glucose.
	b. Fats - reserve sources of energy, some protection - fatty acid, glycerol.
	c. Proteins - building material of enzymes and tissues, a source of energy (especially if malnutrition exists). - amino acids
	d. Vitamins - enzyme assisting material.
	e. Minerals - used in body maintenance and building.
	f. Water - principal solvent in living things.
	Producers are capable of synthesizing carbohydrates, proteins and fats and vitamins while consumers have little ability to synthesize basic nutrients.

MATERIALS

Lugol's
iodine
10% NaOH
3% $CuSO_4$

ACTIVITIES

This topic should be a review from 7th grade science and health. Ask students if they know the tests for the basic foods. If not these may be done by teams of students.

Have students draw a chart of the nutrients, their use and the breakdown products.

Discuss Vitamin D synthesis.

Man and several other "consumers" are able to synthesize some vitamins. Human skin exposed to sunlight stimulates the production of small amounts of Vitamin D.

Starch Test

Prepare Lugol's solution. Dispense from a dropping bottle directly on a sample of the food to be tested. A black or bluish color indicates the presence of starch in the food tested.

Fat Test

Biuret Reaction. To a little egg white in a test tube add an equal amount of water and shake thoroughly. Add an equal amount of 10 percent sodium hydroxide solution and after mixing, add two or three drops of a 3 percent copper sulfate solution. The presence of proteoses and peptones from proteins is indicated by a violet or pink-violet color. Repeat the procedure using a variety of foods.

Key Words

carbohydrates
glucose
fats
proteins
amino acids
vitamins
minerals

Protein Test

Rub a piece of food on unglazed paper, such as a brown paper bag or a piece of ditto paper. Warm the paper gently over a flame or a light bulb. A translucent spot appears on the paper to indicate the presence of fat in the food. This is a common test for fat, but yields negative results with foods having a fat content of less than about 5 percent.

REFERENCE OUTLINE		OBJECTIVES AND UNDERSTANDINGS
2)	Food Consumer Problems	
a)	Nature of the problem	Man is a biological and an economic consumer. As a biological consumer, man eats. Many do not eat properly. As an economic consumer, man purchases food. Many do not purchase wisely.
b)	Biological consumer problems	Some food from the Basic Four should be included in a daily diet. The Basic Four groups include: . the milk group . the meat group . the fruit-vegetable group . the bread-cereal group
c)	Economic consumer problems	Food offered for sale should be: . safe . pure . wholesome . economical

MATERIALS

ACTIVITIES

Consumer use of foods is frequently influenced by fads and opinions rather than purchased through scientific knowledge. Efforts should be made to have pupils understand the value of making food selections based on objective evidence rather than on opinions and attitudes.

Students might make reports of current food consumer problems.

After an overview, the study of consumer problems should become an ongoing project throughout the school year.

Point out the dangers of dieting without the consent of a physician.

The causes of overweight are still under investigation. Other factors may be involved in addition to calorie intake.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

A wise consumer should consider and evaluate:

- the nutritional value of food as well as the cost
- advertising claims
- the method (s) by which the food was processed and preserved
- the ingredients in his food

Methods of perservation include:

- freezing
- canning
- using chemicals, including antioxidants
- drying
- irradiating
- smoking
- cooking

These methods help to control the organisms which spoil food, such as molds, yeasts, bacteria, and worms.

Botulism, some of the ptomaines, trichinosis, and salmonellosis are examples of food-borne diseases.

Food may contain additive substances such as:

- nutrient supplements (vitamins and/or minerals)
- artificial sweeteners
- pesticides and plant hormones
- artificial colors

MATERIALS

ACTIVITIES

Point out that vitamins should be taken only with a physician's consent.

Discuss cuts and grades of meat.

Students may find it of interest to learn the name of the part of the animal and/or plant they eat.

Discuss the methods of food preservation for space voyagers.

Some organisms help to make food desirable e.g., molds - which may add flavor to steak.

Test for Vitamin C

Vitamin C Tablet
2-6 dichloro-indophenol

Prepare a 0.01 percent solution of vitamin C in distilled water, using a vitamin C tablet which can be obtained in a drugstore. A 25 milligram tablet dissolved in 25cc. of water will produce a 0.01 percent solution. The solution may need filtering since the binder used in vitamin C tablets is often insoluble.

Prepare the test reagent by dissolving 1 gm. of 2-6 dichloroindophenol sodium salt in 1 liter of distilled water. The reagent is unstable at room temperature and after being prepared should be kept in a refrigerator when not in use.

Put 1 cc. of the 0.01 percent vitamin C solution in a test tube. You now have exactly 1 milligram of vitamin C in the tube. Add the reagent, which is blue, drop by drop. The first drops will turn colorless in the vitamin C. Continue to add the reagent, shaking after each drop, until a faint blue color persists. The number of drops required represents the number of drops required to neutralize 1 milligram of vitamin C.

Repeat the proceudre using orange, grape and other juices both fresh and canned. The amount of vitamin C contained in 1cc. of the food samples can be determined by simple proportion, using the information gained from neutralizing the vitamin C standard.

Foods such as raw onions, raw potatoes and green peppers can also be tested. Thoroughly macerate the food in water and use the water for testing, since vitamin C is soluble in water.

Acid foods will produce a pink color when the reagent is first added. This is not the end point. A faint blue color must persist.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

- bleaching agents
- flavoring agents
- emulsifiers
- preservatives
- spices
- stabilizers
- thickeners
- leavening agents

The Pure Food and Drug Administration, the Department of Agriculture, and the Federal Trade Commission try to protect the consumer by enforcing government standards.

A wise consumer in the home:

- should wash raw food and use it as soon as possible
- should not refreeze food once it has been thawed
- should not use food from a puffed can
- should refrigerate leftover food
- should prepare food carefully to protect the food's value

MATERIALS

ACTIVITIES

Test several foods for Vitamin C content, (before and after cooking) in order to answer the following questions:

- Is it better to cook foods in a pressure cooker or an ordinary saucepan?
- Does the loss of vitamin C vary with the amount of cooking water?
- Does the loss of vitamin C vary with the cooking time?
- Is there a loss of vitamin C if vegetables are allowed to stand in cold water for any length of time before cooking?
- Does exposure to light and/or air result in a loss of vitamin C in fresh and cooked foods?
- How long do fresh foods retain their vitamin C content?

Discuss enzymes as they may affect food such as the darkening of peeled potatoes and the jellifying of a dessert.

Compare labels of ingredients on various food products.

Key Words

preservative

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
b. Ingestion	The process of taking in food is called ingestion.
	Animals exhibit specialized adaptations for food getting
	Tooth structures of various mammals indicate their diet.

MATERIALS	ACTIVITIES
microprojector	Illustrate various methods of food capture by animals. View Ameba engulfing and Hydra feeding. Discuss star fish-oyster relationship. Illustrate with slides, pictures, film strips - angler fish trap door spider
live frog	frog - demonstrate using meal worms on string anteater
mammal skulls	Compare the tooth structure of various mammals. Ask students through observation to indicate what type of food each would eat.

Key Words

ingestion
adaptation

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
c. Digestion	The process of digestion is one in which nutrients are broken down by enzyme action into end products which can be utilized by the organism.

MATERIALS

ACTIVITIES

Review the parts and function of the digestive tract. The process may be compared in ameba, hydra, earthworm, frog and man. Emphasize similarity of function despite variations in structures.

Discuss how man learned about the digestive tract through the experiments of men like Spallanzani and Beaumont. Point out the role of accidental discovery in obtaining information.

Review the end products of digestion.

With some classes if the function of enzymes in digestion is still not grasped some simple demonstrations may be done.

Action of Ptyalin on Starch

1% starch suspension
saliva
Benedict's solution
cellulose tubing
beaker

Key Words

digestion

During the process of digestion insoluble starch is changed to maltose, a soluble sugar, by the action of ptyalin, a digestive enzyme in saliva.

Prepare a mixture of 1 percent starch suspension and saliva. Test some of the starch suspension and the saliva separately for the presence of sugar using Benedict's solution.

Close one end of a wet, 8 inch length of cellulose tubing by tying a knot in it. Put some of the starch-saliva mixture in the tube, expel all the air and close the other end by tying a knot in it. Be sure that both knots are pulled tight to prevent leakage. Rinse off the outside of the tube to remove any material that may have spilled during its preparation.

Immerse the tube in water in a beaker and set it aside until the next day. Then test the water outside the cellulose tube for the presence of sugar and starch.

A control may be set up in which the saliva is omitted from the starch suspension in the cellulose tube.

A test tube may be used in place of the cellulose tubing.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To identify the effects of various enzymes on food nutrients.

MATERIALS

1% HCl
1% pepsin
egg white

ACTIVITIES

Effect of Pepsin on Protein

Artificial gastric juice can be made from equal parts of a 1 percent solution of pepsin and 1 percent hydrochloric acid. Egg white is a fairly pure source of protein, the nutrient whose digestion is started in the stomach.

Fill a 6-inch length of 2-mm. or 3mm. glass tubing with raw egg white by drawing it up into the tube with your mouth. Coagulate the egg white in the tube by holding it in a beaker of boiling water. With a file, cut the tube containing the coagulated egg white into four pieces of approximately equal length. Put the tubes in bottles containing the following materials so that both ends of the tubes are covered.

Bottle 1. Equal parts of 1 percent pepsin solution and 1 percent hydrochloric acid (artificial gastric juice)
Bottle 2. 1 percent pepsin solution
Bottle 3. 1 percent hydrochloric acid
Bottle 4. Water

Stopper all bottles and leave in a warm place overnight. There will be considerable egg white gone from each end of the tube in artificial gastric juice, indicating that the egg white has been changed to some soluble substance. The fact that pepsin functions best in an acid medium will be indicated by a much smaller amount of digestion in the tube in the pepsin alone. The fact that it is the pepsin and not the acid which functions as the enzyme will be indicated by the lack of any digestion in the tube in the acid alone. The tube in the bottle if water serves as an additional control.

A frog dissection would be a useful activity at this time to show the digestive track. Consider a live dissection. Be certain to pith the frog before beginning dissection.

Skull of frog may be preserved for the later study of the frog brain.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
d. Egestion	Materials which cannot be digested by the organism are removed as waste products. Symbiotic relationships exist between animals and various bacteria in the digestive tracts. The large intestine helps to conserve body fluid by reabsorbing water.

MATERIALS

ACTIVITIES

Compare waste removal by vacuoles in ameba, the two-way tract of the hydra, and the one-way tube within a tube arrangement in animals from earthworm to man.

Examples of symbiotic relationships will occur frequently during the course. For greatest impact and learnings, these examples should be discussed at the time.

Key Words

egestion
symbiosis

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
e. Transport	Single celled organisms simply move materials into and around the cell. Complex multicellular organisms have many cells located far from a source of nutrients and oxygen. The survival of these cells is dependent upon the transport system which brings nutrients and oxygen and removes wastes.
1) Absorption	The movement of molecules from an area of high concentration to an area of low concentration is called diffusion. In certain cases, cells require materials in higher concentration than they are found in the environment. These materials may be moved through a membrane by the expenditure of energy in the process known as <u>active transport</u>. Energy is required to move many end products of digestion into the blood. Most absorption occurs through villi in the walls of the small intestine.

MATERIALS

ACTIVITIES

Experiments and demonstrations on osmosis and diffusion are shown in the Plant Physiology unit.

Show Congo red in the vacuoles of paramecium. Point out that Congo red is not yet truly within the paramecium, as nutrients in man's digestive tract are not yet truly within him.

Key Words

diffusion
transport
absorption

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2) Circulation	Students should be able to list the parts and functions of the circulatory system: three vessels and heart. To be able to distinguish between systemic and pulmonary circulation. To be able to match the three types of cells in blood with the function of each. Red blood cells carry oxygen White blood cells fight disease Platelets function in blood clotting. To be able to contrast anemia, leukemia, and hemophelia.

MATERIALS	ACTIVITIES
chart of human circulation	Review the human circulatory system. Discuss heart disease.
sheep or cow's heart, deer heart	**Dissect a mammal heart.**
live frog to be pithed	Observe the operation of the heart in a pithed frog. Discuss blood transfusions. Students may report on heart transplants. Observe prepared slides of human blood. If such slides are prepared in class, use sterile methods to make smears. Use Wrights stain to bring out nuclei of white blood cells. If frog blood is used, recall that their red blood cells do have nuclei.

Key Words

platelets
pulmonary

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Respiration	The energy trapped in food is released for cell use by the process of respiration.
	To recognize that respiration must be continuous in all living things as the energy releasing process.
	To understand the basic difference between aerobic and anaerobic respiration.
	To detect the end product of aerobic respiration.
	Aerobic respiration provides a greater amount of useful energy per unit of nutrient than does anaerobic respiration.

MATERIALS

1 beaker
1 straw
Bromthymol
Blue solution

ACTIVITIES

Recall the burning of the peanut in measuring Calories. The energy in digested and absorbed nutrients can also be released more slowly (under the control of enzymes) in the process of respiration.

Demonstrate and explain the use of chemical indicators with bromthymol blue solution. Have a student blow bubbles through a straw into the solution until the color changes. What does this test show? Bad breath? No, the presence of an acid and by inference CO_2.

Demonstrate the Carbon dioxide cycle using Elodea and a snail as the living organisms. Bromthymol blue is the indicator.

Fill four bottles with water.

Bottle 1...place snail
2...snail and elodea
3...Elodea
4...control

Seal bottles. Expose to sunlight for 24-hour period. Test for CO_2 at the end of the period.

What results would be achieved if the experiment were replicated and the bottles kept in total darkness for the 24-hour period? Try it.

Key Words

aerobic

anaerobic

REFERENCE OUTLINE

B. Excretion

OBJECTIVES AND UNDERSTANDINGS

Metabolism is the sum of all chemical activities in a organism.

Excretion is the removal of metabolic wastes.

To be able to match the metabolic wastes with the organ of excretion:

Carbon Dioxide - lungs

Water - kidneys
skin
lungs

Nitrogenous wastes - kidney
skin

Salts - kidney
skin

The excretion of wastes by the skin serves as a regulator of body temperature.

MATERIALS	ACTIVITIES
	Recall the frog disection and location of kidneys.
	Discuss excretory structure in lower animals.
battery jars	Demonstrate the effects of heat on the blood supply to the skin.
oral thermometer	Have each student take his temperature during class. Be certain to sterilize the thermometer in alcohol after each trial. Graph results. Show range of temperature readings within a class. Compute the average temperature.

Key Words

metabolism
excretion

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
C. Regulation	Through the process of regulation an organism maintains an internal homeostasis in the face of outside change. Stimuli are outside changes which bring about a response by the regulatory systems.
1. Systems	To be able to compare and contrast the functions of the nervous and endocrine systems.

MATERIALS

large earthworms
flash light or pen light
toothpicks
ammonia or dilute HCl
2 dry cell batteries wired in series

ACTIVITIES

In a darkened room using earthworms kept in total darkness, test light sensitivity with a penlight or flashlight with a pin hole aluminum foil cover.

Test for response to touch with a pencil point.

Hold toothpick dipped in ammonia or dilute HCl an inch away from an earthworm.

Test for electrical response by earthworm on wet paper. Place leads on paper one inch from either end. Reverse leads, then place one inch from either side.

Do not touch toothpick or electric leads directly to earthworm.

Save the earthworms for dissection.

The earthworms may be anesthetized by placing it in cool water and then raising the temperature slowly.

Observe earthworm's nervous system, "Brain", nerve cords ganlion, nerves.

Point out the ventral location of the nerve cord in worms. Compare position of cord in earthworms with dorsal position in vertebrates.

Key Words

stimuli
endocrine

If frog skulls are available from previous experiments, dissect these now to show brain structure. With care, several good frog brain specimens can be obtained.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
a. Nervous system	To be able to recognize a diagram of a nerve cell. To be able to label a diagram of a simple reflex arc, naming the neutrons involved in their correct position. sensory associative motor Nerve impulses are not purely electrical. To be able to match the parts of the brain with their basic functions.

MATERIALS

stop watch
paper strip
5 cm. x 1m.
heavy paper
clip

ACTIVITIES

Reaction time

Average reaction time can be calculated by naving the class stand in a circle with their eyes closed and holding hands. Timer starts the stop watch at the same time as he squeezes the hand of the person next to him. Each person squeezes the hand of the next person immediately upon the feeling of his other hand being squeezed. In this way the stimulus is passed around back to the timer who stops the watch when he feels his other hand squeezed. Divide the total time by the number of students counting the timer twice. This gives average reaction time.

Mark off the paper strip in time intervals. From 0 at the bottom as follows:

Seconds	Millimeters
1/10	49
2/10	196
3/10	441
4/10	784
5/10	1225

Attach the heavy paper clip below the 0 line. Have one student hold his fingers apart around the paper at the 0 line. Tester holds the top of the paper and drops it. The student being tested grabs the paper with his two fingers when it starts to fall. The time markings indicate his reaction time.

Key Words

sensory
associative
neuron
cerebrum
cerebellum
medulla
reflex

Demonstrate reaction time. One student stands with feet together. Tester drops a paper clip in front of him. Height is increased until the student is able to catch the clip with his foot before it hits the ground.

Discuss the pathway of a simple reflex arc such as the Knee jerk. Compare this with the pathways in the reaction time tests.

Have students draw and label a simple generalized nerve cell.

Use a model of a human brain to point out the parts and discuss the functions.

REFERENCE OUTLINE

b. Endocrine system

OBJECTIVES AND UNDERSTANDINGS

The endocrine system is made up of glands which secrete powerful chemical messengers called hormones.

To be able to identify specific endocrine glands given the type or area of regulation.

gland	regulates
thyroid	respiration
pituitary	master gland
pancreas	blood sugar
adrenals	response to stress
gonads	secondary sex characteristics

Hormones are effective in small concentrations. Not all of the effects of hormones are known.

Hormones are important in regulation of reproductive cycles.

*Birth control pills are hormonal in nature.

*optional

MATERIALS

ACTIVITIES

Purpose: To show the effect of hormones on living tissue and organs.

pithed frog
dissection equipment
ringers solution
Adrenalin solution
Acetylcholine (neurohomoh) solution
Petri dishes
3 medicine piplettes

1. Dissect the heart, stomach, and gastrocnemius muscle out of a freshly pithed frog. Rinse in Ringers solution and place all parts in a fresh dish of Ringers solution.

2. Count contractions for 30 seconds. Place two drops of adrenalin solution on each organ and compare.

3. Add two drops per minute of adrenalin, recording changes in activity until all activity ceases.

Rinse tissues well in Ringers solution and place in a fresh dish of Ringers solution.

Repeat steps two and three using Acetylcholine instead of adrenalin.

tadpoles 20
aquarium or fish bowls
thyroid extract pills

Place several tadpoles into two bowls. Add a low concentration of thyroid extract to one bowl. Use the other bowl as a control. Change the water each day adding thyroid extract to the experimental bowl each day.

Key Words

Have students record observations.

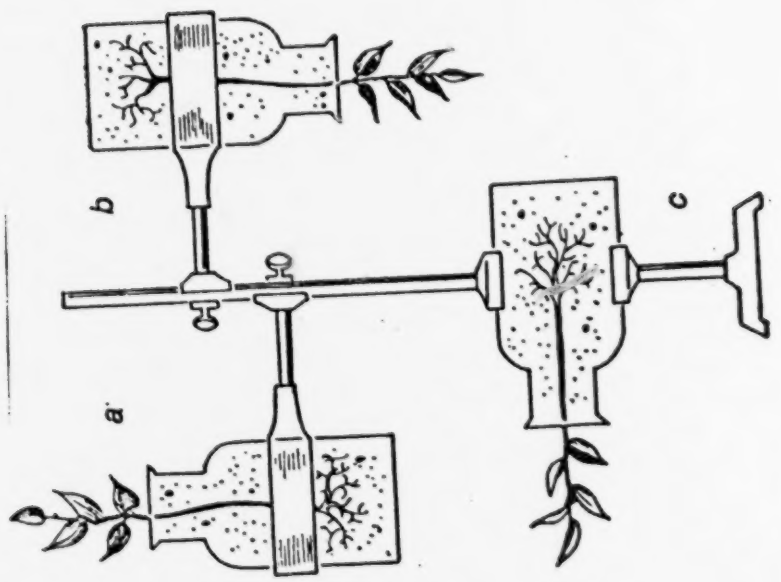
hormones
thyroid
pituitary

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Behavior	A noticeable reaction to a stimuli is known as behavior. To recognize the difference between inborn and learned behavior. (Although it is not always easy to know which type is being displayed by an organism.)
a. Mechanisms	To be able to give examples of the basic categories of behavior from simple tropisms to complex reasoning ability. Tropisms and taxis are simple responses by nonmotile (tropisms) and motile (taxis) organisms respectively. Reflexes

MATERIALS

plant seedlings
wide mouth bottles
ring stand and clamps

ACTIVITIES



A simple experiment on geotropism.

Plant some 3" seedlings as shown in the diagram. Leave in this position for several days and observe stem and root response.

Have students design and carry out simple experiments to illustrate photo and Hydro tropisms.

Recall taxis observed in ameba. Illustrate using paramecium on a slide with a drop of dilute acetic acid observe response under low power.

Review reflex actions.

paramecium
dilute acetic acid
microscope
slides

Key Words

inborn
tropism

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Instincts are not completely understood, but they seem to be an inborn pattern of reflex acts with each response acting as a stimulus to the next response.

Conditioned response. When a new stimuli is substituted for the original one in a simple response.

Habits are automatic behavior which began as a voluntary acts.

MATERIALS

ACTIVITIES

Each species of spider spins a particular kind of web even if it is placed with spiders of a different species. Teacher note: However, environment may alter instincts - drugged spiders spin unusual webs.

Discuss the work of Pavlov in altering stimuli.

Ask students to tap their pencils on the command tap. After 10 times or so begin tapping your ruler when you give the command. Keep up the established beat and after 25 repetitions, stop giving the command, but keep tapping your ruler. Discuss why many students continued to tap.

Condition aquarium fish to being fed when the glass is tapped. Tap the glass when you add food every day for a week. Then tap the glass but do not add food.

Have the students write their names as often as they can in one minute. Then do the same with the other hand. Compare and discuss the role of habits.

Key Words

instinct
conditioning

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Learning includes all processes which lead to changed behavior.

Learning may occur by:

- Imprinting (Patterning behavior from earliest impressions.)
- Trial and error
- Memory
- Reasoning

MATERIALS

ACTIVITIES

Ducks will imprint the first moving organism they see upon hatching as "mother" and follow it as such whether or not it is the real mother or a dog, cat or human.

Many interesting experiments in learning can be carried on with rats, hamsters or mice in a maze.

Mazes may be made simple or complex. The important thing is that there be a number of right-left selections for the animal, one of which in each case leads to a blind end. Performance of the animal in the maze is scored by the number of mistakes made between the time of entering and leaving.

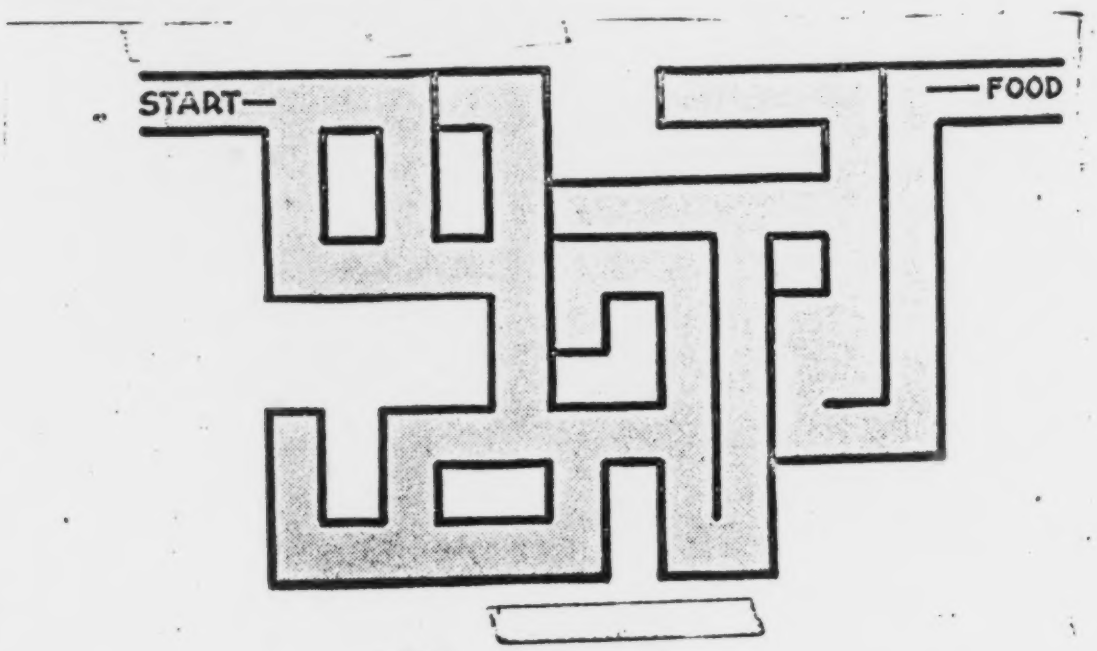
a. Speed of Learning - Withhold food from an animal for 24 hours. Place the animal at the entrance of the maze and a bit of food at the exit. Count the number of errors the animal makes in going through the maze. When he reaches the end, let him eat so that food is associated with completing the task. Repeat the process 10 times and make a line graph of the results of all 10 runs.

Repeat the procedure on several successive days. Is there any evidence of memory on the part of the animal? How many trials does it take for the animal to master the maze, that is run it without a single mistake?

Key Words

learn
memory
reason
behavior

b. Effect of Age on Rate of Learning - Repeat the above procedures, using a young animal and an old one of the same kind. Which learns faster?



REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

There are many difficulties in behavioral studies of animals.

- Are the stimuli received by the animal the same as those received by the observer?

  [Very often no. For example, most animals are color blind, many can hear wave lengths of sound that man cannot.]

MATERIALS

cardboard
cut as shown

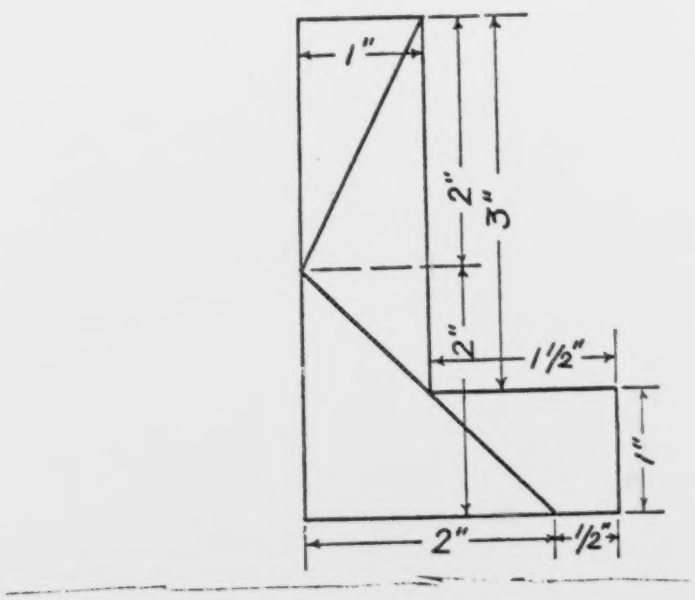
ACTIVITIES

Trial and error learning.

An interesting simple exercise illustrates the improvement that comes through repetition of trial-and-error learning.

Give each pupil four pieces of cardboard cut as indicated in diagram. At a signal, each pupil will begin to arrange the scrambled pieces to form the letter L. Each pupil should keep a record of the time required. As soon as each pupil has completed the task, he should rescramble the pieces and put them together again. When he has completed this 10 times, he should make a line graph of his data.

This typical graph will show marked improvement in time in early trials, with improvement tapering off in later trials.



Discuss learning abilities and "intelligence" in the Dolphins.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Intelligence

There is no agreement as to the definition of the term intelligence, although, it may be thought of as the variation in the rate of learning.

Learning may be improved with training and a better environment.

b. Ecological Approach

Another way of studying behavior is from an ecological viewpoint; "How does the behavior affect the life of individuals and populations?

. Migration of organisms is ecological behavior.

MATERIALS

ACTIVITIES

Each individual human is different from every other human because each has a different combination of experiences. This causes each of us to have different reactions to the same situation.

Read the following list of words to the members of the class, or have the list duplicated. Ask each pupil to write after the word the first word that comes to his mind. It is unlikely that two pupils will have the same list of response words.

table	country	family	school
religion	books	snake	mirror
hat	house	desk	shade
dog	shoe	lemon	diamonds

Have student give brief reports from library or classroom research on the migration of the Artic Tern, Pacific Salmon, American Eel, Monarch Butterfly and Lemmings. What seems to be the nature and mechanisms of behavior in each case?

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Many animals seem to have internal biological clocks which regulate their periodic behavior.

Social behavior is shown by several species.

MATERIALS

potted bean seedlings
dark room

ACTIVITIES

Experiment with the biological clock of bean seedlings. The leaves of bean seedlings droop at night even if they are kept in 24 hour darkness.

Mention grunion spawning runs at exact monthly high tides. The eggs hatch at the next maximum high tide.

Man also has internal biological clocks which are upset when sudden changes over several time zones are made. (Jet travel) These clocks can be reset over a period of adjustment.

Discuss social behavior in ants, bees and termites. A simple ant farm may be constructed from a plaster of paris block. Have students "capture" a queen. Do this by locating a nest and quickly digging up an area around it to a depth dependent upon the species. By carefully sifting through the dirt and following the tunnels the large abdomened queen can be located. The queen, a small number of workers, and some eggs and larva are all that are needed to start an ant farm.

Key Words

social behavior

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Animals often display courtship behavior regulated by breeding seasons.

Territoriality is a commonly observed type of animal behavior.

MATERIALS

ACTIVITIES

Primates also show social behavior, however, primate societies demonstrate learning ability while the social behavior of insects appear to be inborn.

Courtship behavior may be discussed in mountain goats, peacocks, black widow spiders, and post-pubescent Homo sapiens.

Characteristics often found during courtship behavior time: attraction by scent (moths); colorful feathers, fur markings, or clothing (man). There may be a display of battles between contesting males. These battles are usually only vocal or visual, rarely to death.

Territoriality can be reported: sunfish, redwinged blackbirds, howler monkeys, etc.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

It is difficult to determine if Homo sapiens exhibit instinctive behavior.

The sex drive is certainly instinctive.

*Man unlike most animals does not have a specific breeding season. This seems to have functioned in the formation of family groups.

*Gibbons form "Families" of one male, a female, and young. While chimps and gorrillas live in more communal groups with several adults and young.

Mans behavior as a species shows aggression, fear, and prejudice, but also a high degree of cooperation.

Teacher Note:

Another rather unique aspect of man's behavior (aside from his record of killing members of his own species in large numbers) is his ability to poison his environment both externally and internally. Man's activities in the external environment, (Biosphere) are covered in the Ecology unit.

His self pollution through the abuse of Alcohol, Tobacco, and Drugs may be covered here as an aspect of his behavior or in the Body Malfunctions Section which follows as a upset in homeostosis.

*Comparisons between man and the other primates should be made sparingly. Mention that other primates have had a long and separate evolution from Hominidae.

MATERIALS

ACTIVITIES

This will be better understood when "esterus" and menstrual cycle are discussed in the reproduction unit.

Some have suggested that aggression and territoriality may be to some degree inborn.

Most fears and all prejudice are learned.

Key Words

pollution
biosphere
aggression
fear
prejudice

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
II. Malfunctions	
A. Disease	Disease is an upset of homeostasis
1. Causes	
a. External	External (environmental) factors may affect homeostasis.
	Low temperatures
	Reduced oxygen supplies
b. Internal	Invasion of the body by infectious organisms may also upset the balance.
	bacteria
	viruses
	fungi
	protozoa
	worms

MATERIALS

ACTIVITIES

Discuss Pasteur's work with anthrax and Reed's work in connection with yellow fever.

Kinds of Bacteria

Allow a drop or two of saliva to dry on the center of a clean microscope slide, or scrape some material from around the base of the teeth with a toothpick. Spread this material on the center of a slide in a drop of water and allow to dry. Fix the bacteria to the slide by passing it, smear side up, through the flame of a bunsen burner 2 or 3 times. Lay the slide across the top of a beaker and cover the smear with crystal violet stain. After 1 minute, tip the slide so that the excess stain runs into the beaker, and rinse under gently running water until all excess stain has been removed.

Examine under the high power of the microscope. Even under 440X magnification all three types of bacteria--rods, spirals and spheres--should be visible.

If an oil immersion objective is available, put a drop of immersion oil directly on the smear and examine.

Key Words

infectious
bacteria
virus

REFERENCE OUTLINE		OBJECTIVES AND UNDERSTANDINGS
1)	Infectious	Method of contact:
		direct contact
		droplet infection
		soil
		food
		water
		insect and other causes
2)	Non-infectious	
		nutrient deficiences
		abnormal sensitivity to proteins (allergies)
		organ malfunction
		degenerative diseases
		mental disease

MATERIALS

ACTIVITIES

Where Bacteria Can Be Found

Bacteria are found everywhere. When provided with the requirements for growth in a culture medium, each individual bacterium multiplies until it forms a mass called a colony, large enough to be seen with the naked eye. The number of colonies of bacteria on a plate after several days of incubation, therefore, indicates the number of individual bacteria originally placed on the agar.

Prepare 8 or 10 petri dishes of nutrient agar for bacterial cultures. Leave each in a warm place for 24 hours to be sure it is sterile: nonsterility will be indicated by the appearance bacterial colonies.

Expose four or five of the plates to the air in various locations by removing the cover for 10 or 15 minutes. Such places as the locker room, the cafeteria serving counter, the classroom while being swept by the janitor, or the corridor during the passing period may yield interesting results. Label the places, indicating where, when and for how long exposed.

Touch common objects lightly to the surface of the agar in the remaining plates. Try not to break the surface of the agar. Such objects as pencils, combs, coins, doorknobs, fingers, hair or books may be used. Label these plates to indicate what objects were used to touch the agar.

Leave all the plates for a day or two in a warm, dark place such as an incubator. If no incubation is available, they can be placed in a drawer or cupboard at room temperature for 2 or 3 days. Growth is slower at room temperature than at body temperature or in an incubator.

At the end of a day or two, observe the plates and count the number of colonies on each. Each colony indicates a single bacterium originally placed on the agar.

Do not open the plates during the observation.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

Bacterial Growth Conditions

An easy way to inoculate a number of culture plates with approximately equal numbers of bacteria is simply not to sterilize either the nutrient, agar or the petri dishes. Spores found on the glassware and falling from the air will do a good job of inoculation.

Prepare eight plates of nutrient agar in this manner. As soon as the agar has solidified, the plates must be kept refrigerated until used. They should not be prepared more than 2 days prior to use, for there may be some slight growth of bacteria under refrigeration.

Heat 1.5 gm. of powdered plain agar on 100 ml. of water until dissolved. Pour some of this into an unsterilized petri dish and refrigerate until used. This will be inoculated the same as the others, but contains no food.

a. Temperature - Place one inoculated petri dish of nutrient agar in an incubator, another in the food compartment of a refrigerator and a third in a dark drawer at room temperature. The only variable here is that of temperature, all other conditions remaining constant. Examine daily for 2 or 3 days and compare visible growth in each.

Key Words

inoculate

b. Moisture - Remove the cover from one inoculated petri dish of nutrient agar. This will allow it to dry out rapidly so that moisture is not available to the bacteria. Place the opened dish together with a covered one for a control, in an incubator. Examine both dishes for 2 or 3 days and compare visible growth in each.

c. Light - Place one inoculated petri dish of nutrient agar in a dark drawer at room temperature and another under an electric lamp. Examine daily for 2 or 3 days and compare visible growth in each.

d. Availability of Food - Place the inoculated petri dish of plain agar and one of nutrient agar in an incubator together. Examine daily for 2 or 3 days and compare visible growth of each.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Disease Control	Immunity is the ability of the body to resist a disease.
a. Individual	
1) Natural	Natural Defenses
	. Reflexes (coughing, sneezing)
	. Skin, tears
	. Mucus membranes
	. Digestive juices
	. White blood cells
	. Antibodies
	If the body defenses are penetrated, the body responds to infection by:
	local inflamation
	fever
	producting antibodies
2) Artificial	Artificial Defenses
	. Receiving antibodies
	. Receiving small quantities of infectious agents or their products.
	. Antibodies

MATERIALS

ACTIVITIES

Most bacteria are harmless and many are helpful to man.

Discuss representative diseases.

Calculating the Relative Number of Bacteria in Water Samples

Sterilize some screwcap bottles in the oven at 350°F for 1 hour. In these bottles collect samples of water from various places, such as the water tap, a pond, ditch, stream and lake. Bring these to the laboratory without delay and determine the number of bacteria in 1 cc of each, using the method described below:

Prepare five test tubes, each containing 9cc. of distilled water. Plug the tubes with cotton and sterilize in a pressure cooker at 15 pounds pressure for 30 minutes. With a sterile pipette, carefully place 1 cc. of the material to be tested in one of the tubes of sterile water. rotate the tube between the hands rapidly several times to mix thoroughly. Take 1 cc. from this test tube and add to a second tube of sterile water, mixing thoroughly. Continue in this manner until all five tubes of sterile water have been inoculated.

Key Words

immunity
reflex
antibodies

This procedure will produce dilutions of the material to be tested of 0.1, 0.01. 0.0001 and 0.000001. These dilutions are necessary because bacteria may be so concentrated in the sample that it will be impossible to count individual colonies in the next stage of the procedure.

Transfer 1 cc. of the liquid in each to the surface of individual sterile petri dishes of nutrient agar. Tilt the places back and forth so that the liquid is distributed over the entire surface of the plate. Incubate for 24 hours and count the individual colonies on each plate. On some plates colonies may be so abundant that it is impossible to count them, while on others there may be very few. Plates having 50 to 100 colonies probably produce most accurate results. The number of bacteria in the original sample of water can be calculated by multiplying by the proper dilution factor.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Public	Quarantine
	Food control
	Use of insecticides (point out the many harmful ecological aspects of the use of certain insecticides.)
	Use of antiseptics and disinfectants
	Water purification
	Mass inoculations

MATERIALS

ACTIVITIES

Spread of Pathogens

Pathogenic bacteria are spread by a number of methods, some of which can be demonstrated in the laboratory. In these exercises, the mere fact that bacteria are spread by various methods is all that is indicated. There is no simple way to determine whether the bacteria found on the cultures are pathogenic or not.

a. Bacteria Spread by Droplet Infection - Prepare several sterile petri dishes of nutrient agar. Have pupils with colds cough vigorously into the plates - a separate plate for each pupil. If possible, have a pupil with a cold sneeze into a plate. Incubate and observe for bacterial colonies.

b. Bacterial Spread by Flies - Prepare a sterile petri dish of nutrient agar. Capture a fly and put it in the plate for several minutes so that it walks around on the surface of the agar. Incubate and observe for bacterial colonies. Bacteria carried in this way may get on food contacted by the fly.

c. Bacteria Spread by Contaminated Water - Sterilize a small screwcap jar by placing in an oven for one hour at 350°F. Use it to collect some water from a stagnant pond or polluted stream. Pour a little of the water onto the surface of sterile nutrient agar in a petri dish. Swirl the plate gently so that the water covers the surface and pour off any excess. Incubate the dish a day or 2 and examine for bacterial colonies.

Caution: Do not open dishes while observing. Sterilize cultures immediately after use.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
B. Alcohol, Tobacco and Drugs	Another area of upset in internal homeostasis involves the abuse of alcohol, tobacco, and drugs. Abuse may be considered to be either a psychological or a physical dependence upon these non-nutritive substances. In most cases, this dependence in the user, can be linked to personal, mental, social, and emotional problems.
1. Alcohol	Grain (ethyl) alcohol is produced by the fermentation (anaerobic respiration) process. In this process yeast organisms obtain energy from sugar and leave alcohol and carbon dioxide as waste products.

Type	Produced by Fermentation of	Alcoholic Content
Wine	juice of fruits, berries and vegetables	14 to 30%
Beer/Ale	cereal grains	3 to 6%
Whiskey/Gin	grains with the products distilled	30 to 50%

Alcohol acts as a depressant. It is absorbed directly into the blood stream, is carried to the central nervous system and slows the activity of the control centers.

At concentrations above .15% in the blood, there is a loss of judgment and inhibitions. There is also a definite slowing of response to stimuli.

At concentrations above .5% death may result.

Alcoholics are subject to deficiency diseases.

MATERIALS

ACTIVITIES

Students should be informed about the scientific facts of alcohol, tobacco and drugs. They should have some background from a Jr. High health course. They may not know as much as they think, however. A pretest of their knowledge might be a way of determining this.

Then discussions and reports could be given in areas where they are misinformed.

REFERENCE OUTLINE

2. Tobacco

OBJECTIVES AND UNDERSTANDINGS

Dried and processed leaves of the tobacco plant.

This product may contain as much as eight per cent of the poison nicotine. This nicotine is inhaled in smoke along with tars and other chemicals (carbon monoxide).

Nicotine acts as a stimulant and temporarily increases the rate of body activity by acting on the central nervous system.

Nicotine is classed as a habit forming drug.

A relationship between cigaret smoking and cancer has been established. Increased smoking correlates with increased chances of death from cancer and heart disease.

MATERIALS

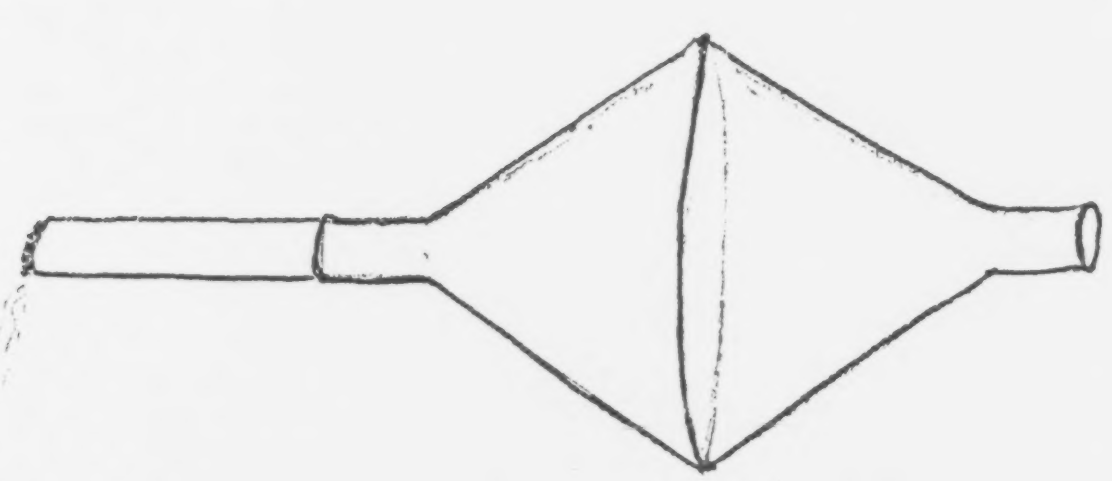
cigarets
2 small glass funnels
filter paper
tape

ACTIVITIES

Discuss studies of cancer induced by tars on mice.

Point out that the statistical evidence of the harmful effects of cigarets took many years to develop.

Have a smoker smoke a cigaret through a filtering device, such as the one shown. Then have them smoke a cigaret directly. They should exhale each puff through the filtering device. Compare the two filters. "Where are the tars from the second cigaret?"



Key Words

narcotic
cancer

REFERENCE OUTLINE

3. Drugs

OBJECTIVES AND UNDERSTANDINGS

Drugs may be classified on the basis of the effect that they have on the body.

Depressants - Barbituates (Sleeping pills)

Stimulants - Amphetamines (Bennies, pep pills)

Hallucinogens - L.S.D., Marihuana

Solvents - Glue (upsets the sense organs)

Narcotics - Heroin, codeine, Morphine. These drugs may become addicting after a few doses.

MATERIALS

ACTIVITIES

Discuss the usefulness of tranquilizers, sleeping pills and sedatives when prescribed by a doctor.

Barbiturate poisoning is the leading cause of adult death by poisoning.

When barbiturates are taken in combination with alcohol, the result can be fatal.

Large doses cause intoxication and continued unsupervised use leads to dependency. Sudden withdrawal may result in death.

Overdose results in loss of judgment.

Alternate use of barbiturates and amphetamines can lead to serious mental illness.

Overuse can result in addiction.

Teacher Note: Marihuana in the form usually found in the United States is a comparatively mild drug. There are at present no known harmful physical effects, although this may be due to a lack of research on long term users.

There does seem to be some psychological dependence for some users. In some users the creation of a false sense of accomplishment and a feeling of creativity are found which is not actually demonstrated to the outside world.

The illegal nature of the drug tends to bring users in contact with sources of "harder" narcotics which are physically addicting.

L.S.D. is an extremely powerful and dangerous drug. The results of individual use are unpredictable. Hallucinations, with waking dreams or nightmares (depending on the trip) are most common. A temporary psychosis which may reoccur without taking the drug is common. There is some evidence of chromosome damage. Extreme depression and suicide have followed use of the drug.

The hard narcotics are characterized by an increasing dosage needed to feel the effect, increased need for the drug and high prices charged by organized crime. There is an extremely poor record of any permanent cure for addicts.

UNIT III - PLANT PHYSIOLOGY

I. Plant Physiology

A. Classification

1. Non-Vascular

a. Algae

b. Fungi

c. Mosses

2. Vascular

a. Roots and Root Hairs

b. Vascular or Conducting Tissues

(1) Xylem

(2) Phloem

(3) Cambium

c. Stems

d. Leaves

B. Photosynthesis

1. Description

2. Process

3. Rate

C. Respiration

D. Flower

1. Function

2. Structure

3. Adaptation

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
I. Plant Physiology	To recognize the various plant structures and their functions. To recognize general plant characteristics. To understand the role of green plants in the web of life. To discover the interrelationship between plants and their environment.
A. Classification*	Biologists have not agreed on the division of the plant kingdom (Phyla). Groupings of plants maybe introduced by using a variety of plants and allowing the students to decide or list differences and similarities between plants. For simplicity plants may be grouped as non-vascular and vascular.
1. Non-vascular	Algae and fungi are very simple organisms lacking roots, stems, and leaves. They may be considered as simple plants.
a. Algae	Algae contain chlorophyll and live in water or very moist places.

*Teachers should use a generalized classification scheme with stress on major characteristics rather than the memorization of phyla and classes.

MATERIALS

water samples
slides
cover slips
microscope
medicine
droppers

ACTIVITIES

Collect samples of water from several different sources such as puddles, ponds, lakes, slow-moving streams, and aquariums. You may also find algae clinging to stones, to the bark of trees, and to clay pots in shaded gardens. Label each container with the location from which each sample is obtained. Place a few drops of the samples on a slide. Place a cover slip over the sample. Try to find examples of algae by observing carefully under low power.

Use a table such as the one shown below in recording your observations. Indicate whether or not you can see chlorophyll. Are the chloroplasts in the cells grouped or spread out? Are there other color pigments? Estimate the size of a single cell. Indicate the form of algae (unicellular, multicellular).

Location	Form	Chlorophyll & Chloroplasts	Color of Pigments	Size (in mm)
1.				
2.				
3.				

Key Words

phyla
function
characteristics
inter-
relationships

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
b. Fungi	Fungi lack chlorophyll and cannot make their own food. Among the most familiar fungi are molds, mushrooms, and yeasts.
c. Mosses	**Mosses are more complex than algae and fungi.** Mosses are small green plants with leaf like and stem-like structures. They lack roots. Mosses live in a variety of habitats.

MATERIALS

petri dish
microscope
slides
cover slips
forceps
dropper
bread

ACTIVITIES

Place some bread* in a Petri dish. Moisten the bread with a small amount of water. Expose the uncovered Petri dish containing the bread to air for an hour. Toward the end of the class period, put the cover back on the Petri dish and put the dish in a dark, warm place.

Observe the Petri dish daily, record any changes which you notice in the bread, use a microscope to observe the mold.

Put a drop of water on a slide. Using forceps, carefully remove a small amount of the mold from the bread. Place this into the drop of water and cover with a cover slip. Examine under high power. Describe and make sketches of what you observed.

*A preservative is usually added to bread to keep it "fresh". This preservative inhibits the growth of mold. Obtain, if possible, a slice of French, Italian or German breads baked in a local bakery rather than bread which is massed produced. A slice of homemade bread would be ideal for this experiment.

Key Words

fungus
chlorophyll
moss

REFERENCE OUTLINE		OBJECTIVES AND UNDERSTANDINGS
2. Vascular Plants		Vascular plants containing roots, stems, and usually green leaves are often grouped together. To compare the roots of seed plants to see if they vary.
a. Roots and root hairs		All roots have two general functions: ·anchorage by the root ·absorption of water and minerals through the root hairs. Additional root functions are: ·food storage ·transportation of materials
b. Vascular or conducting tissues		
	(1) xylem	Xylem cells conduct water and the dissolved minerals upward in plant.
	(2) phloem	Phloem cells carry food to all parts of the plant. Xylem and phloem cells extend from the root to the leaves.

MATERIALS

ACTIVITIES

A. Many students develop special interest in plants if they have themselves nutured them.*

B. The movement of materials in plants is due to osmosis and diffusion.

1. Demonstration of Osmosis
   Procedure: Prepare three sugar solutions of the following concentrations: 1%, 5%, and 20%.

2. Place a drop of each solution on a slide. Place a few short threads of the algae in each drop; add a cover slip to each. Do not allow drops to run together.

3. After 10 minutes, examine each solution under the high power.

4. Make drawings of one cell in each of the sugar solutions. Explain observations and results.

   Note: Three separate slides with the different concentrations of sugar solution and algae may be used.

Key Words

osmosis
diffusion
root
root hairs
absorption

* Refer to: BSCS Green Version, High School Biology, 2nd edition, p. 470, Investigation 13.3 Rand, McNally, 1968

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTNADINGS
3. cambium	The cambium layer of cells is the growth layer between the xylem and the phloem.
	To compare the effects of two processes: diffusion and osmosis.

MATERIALS

oil of cloves
(peppermint or
strong perfume)
petri dish
beakers
potassium
permanganate
crystals
copper sulphate
crystals (small)
ink

ACTIVITIES

The Process of Diffusion

Procedure:

Test 1. Fill a beaker 1/2 full of water. Drop a crystal of copper sulphate in at a given time.

Students record time it takes for for the crystal to diffuse. Since this takes a longer period than other diffusions, start this test first and go on with the other tests.

Test 2. Fill a beaker 1/2 full of water. Drop several crystals of potassium permanganate into it. What happens? Why?

Test 3. Fill a beaker 1/2 full of water. Add several drops of ink to the beaker. Explain observations.

Test 4. Expose several drops of oil of cloves on a Petri dish or watch glass. Allow the drops to diffuse. Ask how many students can detect an odor.

When the odor has reached the last row, ask students to explain how the odor can be detected by most of the class, if the oil is in a dish at the front of the room. Determine the time it takes for the molecules to travel throughout the room.

Key Words

cambium layer
diffusion

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To observe the process of Osmosis.

When water moves from an area of high concentration to an area of low concentration through a membrane, the process is called osmosis.

MATERIALS

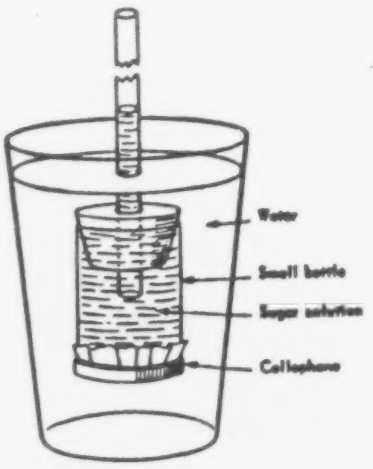
ACTIVITIES

Demonstrate the process of osmosis using s semi-permeable membranes.

See various textbooks for different methods of demonstrating osmosis.

Remove the bottom from a small glass bottle about 2.5 cm in diameter. Fit a one-hole stopper tightly into the bottom and put a 50 cm length of glass tubing or a length of two soda straws through the hole.

Place a piece of cellophane or parchment paper over the other end of the bottle and fasten it securely by winding with several turns of string or strong thread. Fill the bottle with a very concentrated sugar solution and replace the one-hole stopper being sure that no air bubbles remain inside the bottle. Clamp the osmometer in a glass of water and allow to stand a few hours.



REFERENCE OUTLINE

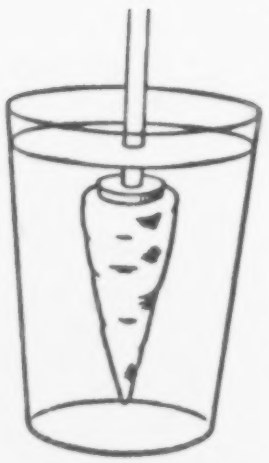
OBJECTIVES AND UNDERSTANDINGS

Note to teacher: Students may be familiar with the process of osmosis from seventh grade general science Do not repeat unless for review purposes.

MATERIALS

ACTIVITIES

Select a carrot which has a large top and which is free of breaks in its surface. With a sharp knife or an apple corer cut a hole in the top of the carrot about 2 or 2.5 cm in depth. Be careful not to split the top. Fill the cavity with a concentrated solution of sugar. Insert a tightly fitting one-hole cork or rubber stopper which carries two soda straws pushed together or a length of glass tubing. Place in a jar of water for a few hours. If your cut in the top of the carrot has not been even it may be necessary to seal the cork in with some wax dripped from a burning candle.



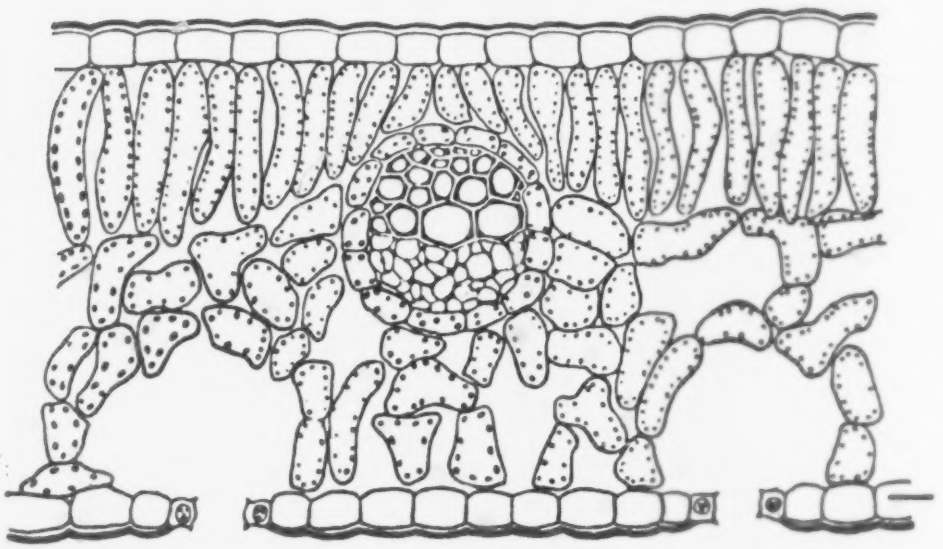
Place some dilute hydrochloric acid or strong vinegar in a shallow dish, such as a saucer, to a depth of about one centimetre. Hold the large end of an egg in the acid until the shell has been eaten away on the end leaving the thin membrane exposed. Rinse the acid from the egg. With a sharp instrument work a small hole through the shell at the other end. Insert a soda straw or a length of glass tubing through the hole into the interior of the egg. Seal the opening around the tube with household cement or sealing wax. This must be absolutely tight. Place the osmometer in a glass of water and let it stand for a few hours.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
c. Stems	Stems, like the root, contain xylem and phloem tissue. The most important activities carried on by the stem are: support storage conduction
d. Leaves	Leaves are generally considered the main organs of photosynthesis. Leaves are the "food factories" of the world. Students should be able to identify the various structures and function of the leaf. Some leaf structures: 1. chloroplasts 2. stomates 3. guard cells 4. epidermis

MATERIALS

prepared cross sections of lilac leaves (one per student)
microscope
fresh leaves
slides
cover slips
single-edged razor blade
prepared drawing of leaf cross section

ACTIVITIES



Look at the details of a leaf and see if we can relate its function to its structure. The leaves should be from plants such as Tradescantia or any plants from which the student can strip the lower epidermis. Try several types and select the best ones before class starts. Stress powers of observation.

Key Words

chloroplast
stomate
guard cell
epidermis

REFERENCE OUTLINE

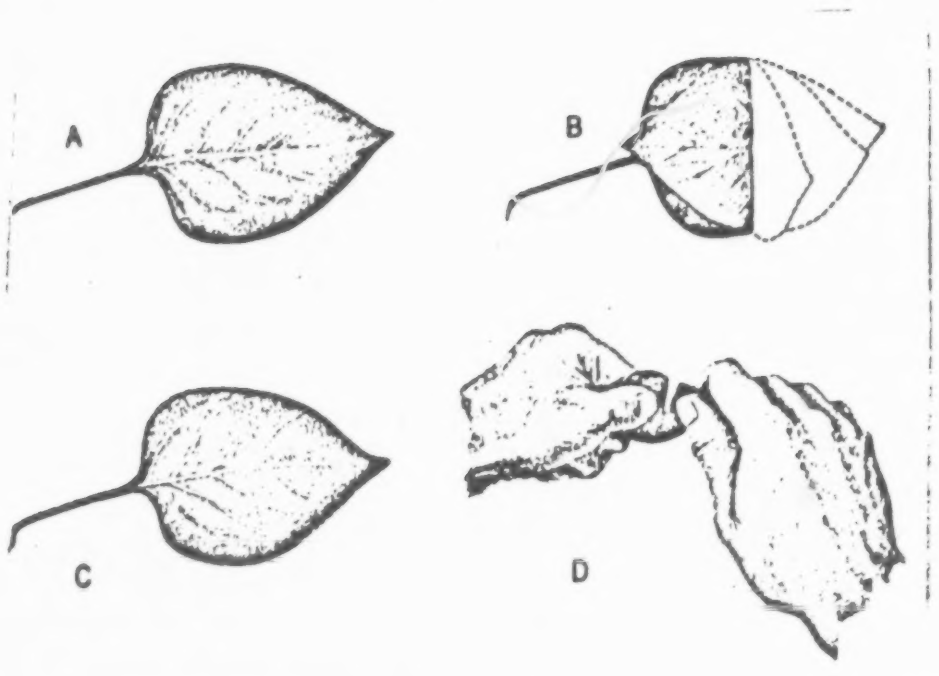
OBJECTIVES AND UNDERSTANDINGS

To learn how to prepare a leaf for examination under a microscope and to observe its parts.

MATERIALS

leaf
razor blade
microscope

ACTIVITIES



How to strip the lower epidermis from a leaf.

Key Words

cross section

Place a piece of the epidermis on a clean slide. Add a drop of water to the epidermis and cover with a cover slip. Observe the cross section of the leaf under low power first. Compare what you see with the prepared drawing. Do not expect the two to look alike, but you should be able to see that the general structures are the same.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
B. Photosynthesis	Photosynthesis is the fundamental process of food manufacture in green plants.
1. Description	Photosynthesis is a complex series of chemical changes in which carbon dioxide and water are combined in the presence of chlorophyll to form sugar which may be changed to starch. Sunlight is the source of energy for this reaction. Photosynthesis takes place inside the chloroplasts. The sun is the earth's important source of energy. Green plants trap this sunlight energy and store it with the aid of light trapping pigments called chlorophylls.

MATERIALS

Coleus plant
alcohol
iodine or
Lugol's solution

ACTIVITIES

Is chlorophyll necessary for photosynthesis?

The purpose of this investigation is to find whether or not chlorophyll is necessary for photosynthesis. One way to do this is to find the presence of some product of photosynthesis, such as food, in those parts of the leaf that contain chlorophyll. Starch is a storage product of photosynthesis. When green leaves are engaged in making food, starch is formed in the leaf. The presence of starch is determined by the use of iodine or Lugol's solution.

Immerse a Coleus leaf in boiling water for a few minutes to soften the leaf so that the chlorophyll can be extracted.

Place leaf in a beaker of warm alcohol until the color is extracted.

When the green pigment has been extracted, test leaf for presence of starch.

Key Words

photosynthesis
chlorophyll
starch
glucose
transpiration

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Chlorophyll is usually located in small bodies called chloroplasts.

Chlorophyll is the substance which traps the light a plant uses to make food.

Chlorophyll is the catalyst during photosynthesis.

A leaf may absorb up to 90% of the light which strikes it, but only 2% to 12% of the light energy becomes chemical energy.

Most of photosynthesis (about 80%) occurs in the waters and is carried on by algae.

2. Process

A simplified summary equation for photosynthesis is:

$$\text{water} + \text{carbon dioxide} \xrightarrow[\text{(chlorophyll)}]{\text{(light)}} \text{glucose} + \text{oxygen}$$

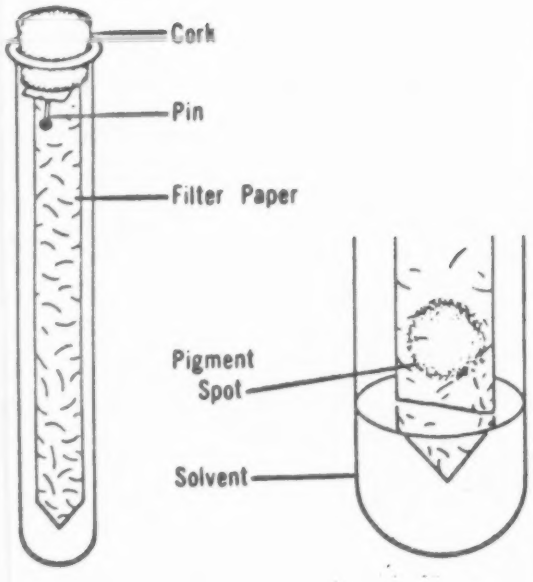
Water for photosynthesis enters plants through the root hairs.

Carbon dioxide and oxygen diffuse through the stomates of the leaf.

The diffusion of water vapor through the stomates into the atmosphere is called transpiration.

MATERIALS

chromatography paper
extracted chlorophyll
large test tube
pins
medicine dropper
solvent mixture
petroleum ether - 90%
acetone - 10%



ACTIVITIES

The problem to investigate is whether the green colored matter in leaves contains one or more than one pigment. Paper chromatography is one method for separating different kinds of substances in solution.

Students may work individually or in small groups.

Cut a strip of chromatography paper about 1/2" wide. Attach the strip to a cork with a pin so the paper hangs down inside the test tube but does not touch the sides. The tapered end of the paper should reach to within 1/2" of the bottom of the test tube. See diagram.

Remove the cork and paper. Pour one inch of solvent into the tube.

Next strain the filter paper. Using a medicine dropper, place a drop of green pigment extract near the center of the paper strip about one inch from the bottom. Allow this spot to dry, then add another drop on top of the first. Repeat this procedure until the spot is dark green.

Hang the paper strip in the test tube so the tapered end of the paper is in the solvent, but the paper does not touch the sides of the tube.

After ten minutes, observe what is happening to the pigment as it dissolves and moves along the strip.

Make a sketch of the strip labeling the colors of the pigments.

Return the paper strip to the solvent and allow the pigment to rise almost to the top of the paper. Remove the paper and sketch the strip. Label the colors of the pigments.

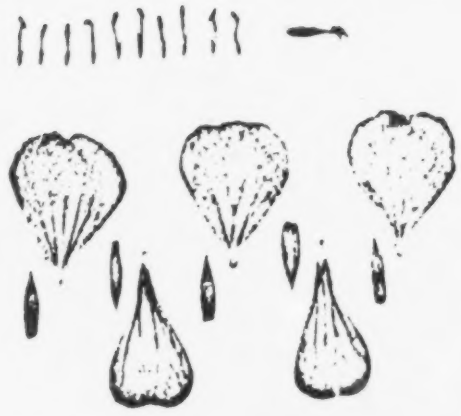
REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
3. Rate of Photosynthesis	Photosynthesis may be affected by a. light b. temperature c. water d. carbon dioxide e. minerals
C. Respiration	Respiration occurs in plants and animals all the time. The leaf and the root may function as respiratory organs. Photosynthesis, green plant process, occurs only when light is present.
D. Flower	
1. Function	The flower is a reproductive structure.
2. Structure	The typical flower consists of the following parts: stamens pistil sepals petals

MATERIALS

ACTIVITIES

Parts of a Flower

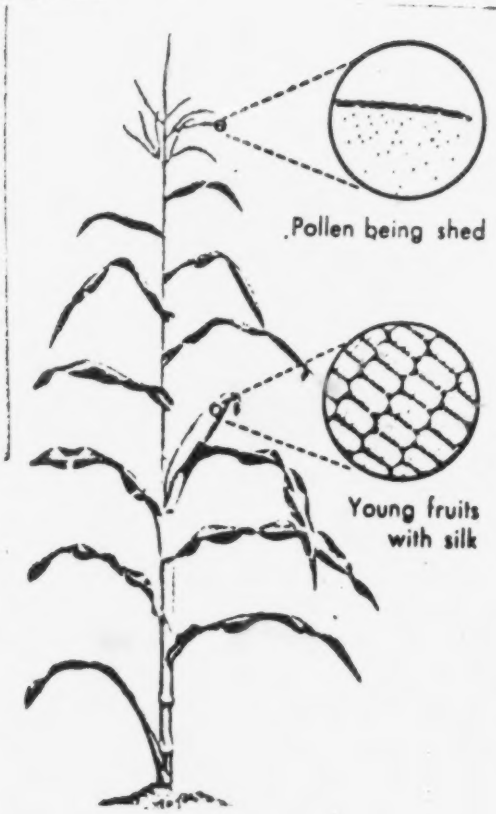
A complete flower.



Parts of a dissected flower.

Key Words

stamen
pistil
sepal
petal



The corn plant has two kinds of flowers. The tassel is the pollen-producing flower and the ear is the ovule-producing flower.

REFERENCE OUTLINE

3. Adaptation

OBJECTIVES AND UNDERSTANDINGS

Flowers show many adaptations which help to insure that their function will be performed.

Some flowers close at night, or when the weather is damp.

Some insects are attracted through odor or color.

Some flowers have unusual shapes which insure that pollen will be transferred from flower to flower.

MATERIALS

ACTIVITIES

Key Words

respiration
adaptation

UNIT FOUR - REPRODUCTION AND DEVELOPMENT

I. Reproduction and Development

- A. Need for reproduction
- B. Reproductive processes
  - 1. Asexual
    - a. organismic
    - b. cellular
  - 2. Sexual
    - a. fertilization
    - b. meiosis
    - c. animals, organismic
- C. Human reproduction
  - 1. Structures
    - a. male
    - b. female
      - (1) menstrual cycle
  - 2. Development of embryo
  - 3. Postnatal care

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
I. Reproduction and Development	
A. Need for Reproduction	Survival of individuals depends upon their ability to carry out the life activities. Survival of a species depends upon the ability of the individual to successfully reproduce. To learn how the survival of a species depends upon the ability of individuals to reproduce successfully. To demonstrate experimentally that life comes from pre-existing life.

MATERIALS

2 straight glass tubes, 30 cm long
bunsen burner with wing top
rubber stoppers
2-one hole
3 without holes
straight glass tube, 7-8 mm diameter, 8-10 cm long
bouillon cube
1,000-ml beaker
stirring rod
100-ml graduated cylinder
250-ml Erlenmeyer flasks
autoclave or pressure cooker
paraffin or sealing wax
250-ml beaker
cotton

KEY WORDS

spontaneous generation

ACTIVITIES

Discussion - What would happen if a species stopped reproducing?

Set up re-enactments of the experiments by Spallanzani and Pasteur attempting to disprove the theory of spontaneous generation.

Procedure

Using the wing-top burner, bend one of the 30 cm lengths of glass tubing into an S-shape. Keep the other piece straight. Insert them into one-hole stoppers.

Dissolve one bouillon cube in 500 ml of warm water. When it cools, filter if necessary. The broth must be sparkling clear. Pour 70 ml of the clear broth into each of seven flasks. Number the flasks with pencil and treat them as follows:

Flask 1. Overall control
Plug with solid stopper. Do not heat.

Flask 2. Spallanzani's control flask
Add 10 ml of water. Boil gently for fifteen minutes. About 10 ml of water will boil off, making the level approximately the same as in the other flasks. Leave open.

Flask 3. Spallanzani's experimental flask
Add 10 ml of water. Boil gently for fifteen minutes, with solid stopper resting at an angle in the mouth of the flask. At the end of the boiling, plug immediately with stopper. Seal with wax or paraffin. To do this, melt paraffin in beaker. Apply with wad of cotton held by forceps.

Flask 4. Pasteur's control flask
Heat in pressure cooker or autoclave for fifteen minutes at 15 lbs pressure. Leave open.

Flask 5. Modified Pasteur's control flask
Plug with a stopper through which the straight glass tube has been inserted. Heat in the pressure cooker or the autoclave as for flask 4. Then seal with paraffin around the neck of the flask and around the tube where it comes through the stopper.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

Flask 6. Pasteur's first experimental flask
Plug with a stopper. Heat in pressure cooker or autoclave as for flask 4. Then seal as for flask 5.

Flask 7. Pasteur's final experimental flask
Plug with a stopper through which the S-shaped glass tube has been inserted. Heat in pressure cooker or autoclave as for flask 4. Seal as for flask 5.

Put all flasks on a laboratory table (not in direct sunlight or over a radiator).

KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

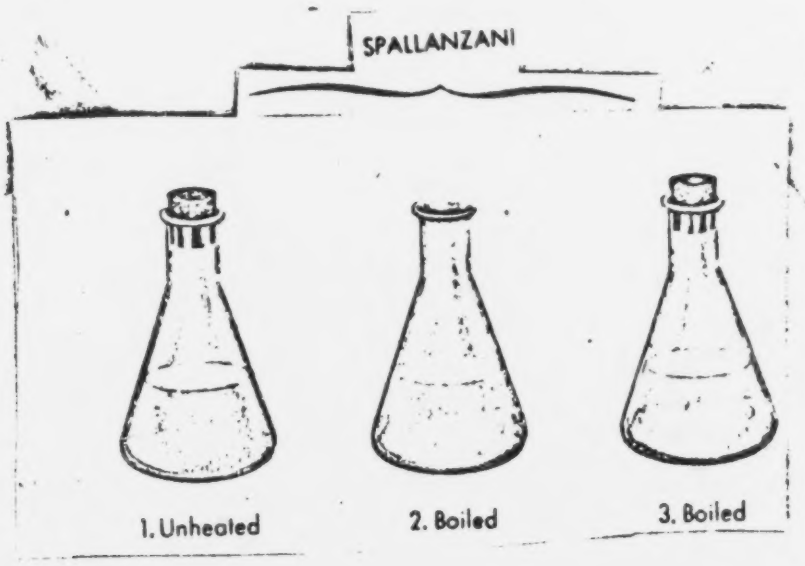
To realize that men have not always known that living things can only come from previously living things.

MATERIALS

ACTIVITIES

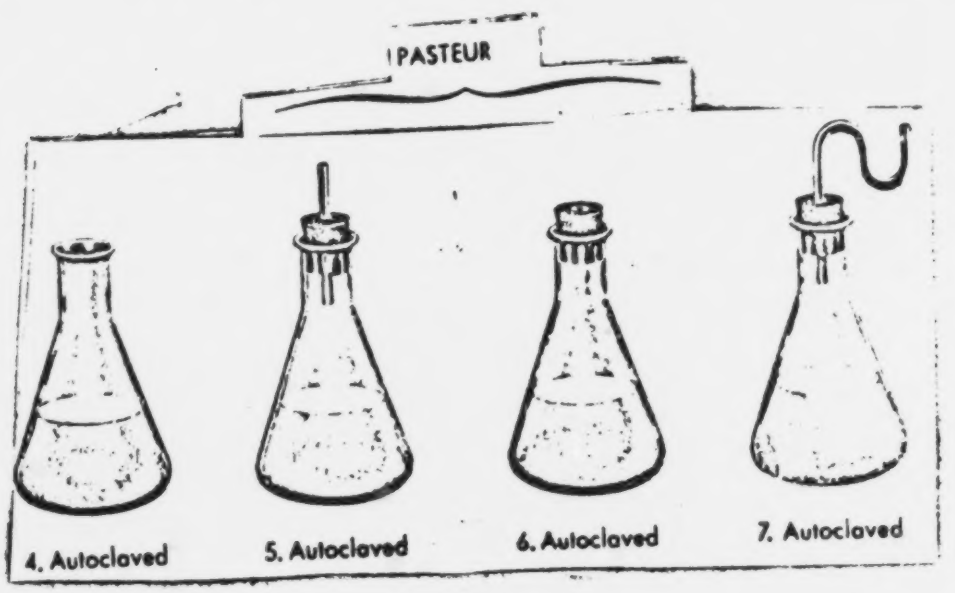
Discuss the beliefs in spontaneous generation widely held during the middle ages. (Snakes from sticks, frogs from mud, flies and mice from garbage, etc.)

Replicate and/or discuss Spallanzani's experiment to identify factors leading to the non-acceptance of his results.



Compare Pasteur's experiment with Spallanzani's findings. From the reports of these experiments have pupils list evidence for and against the theory of spontaneous generation.

KEY WORDS



REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
B. Reproductive Processes	
1. Asexual	Asexual reproduction is one method used by organisms to continue their species.
a. organismic	To learn the details and mechanics of the asexual method of reproduction.

MATERIALS

portion of sprouting potato.
strawberry or other plant with runners
bryophyllum leaf with new plants at notches.
various rooted cuttings-geranium coleus, ivy, cactus
culture of budding yeast cells.
budding hydra-live or slides.
protozooans undergoing fission.
microscopes
hand lenses

ACTIVITIES

An observational laboratory exercise or examples of asexual reproduction. Place enough numbered and labeled (with names) examples around the room so that each pair of students can observe one at a time. Give enough time for observations and then have them move on to the next example.

Have students record their observations in a chart such as this:

	ORGANISM	ORIGIN OF OFFSPRING	NUMBER OF PARENTS	APPEARANCE OF OFFSPRING COMPARED TO APPEARANCE OF PARENT
Example:	Yeast	Branch of parent (bud)	One	Same, but smaller

Coleus Propagation

three varieties of Coleus labeled A, B, and C
rooted cuttings from each labeled D, E, and F

Have pupils match the cuttings with the parent plant from which they came.

Then ask -

Why did you identify a particular plant with a particular cutting?

KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To differentiate between types of asexual reproduction.

Ferns, fungi, and bacteria reproduce by means of spore formation.

Fission - equal splitting.

Budding - equal splitting of the nucleus but unequal division of the cytoplasm.

Vegetative propogation.

Spore formation.

MATERIALS

bread (home baked)
hand lens
microscope

ACTIVITIES

Prepare a bread mold culture. Use home baked bread. Preservatives in the commercial product will retard mold growth. Have moistened bread exposed to air and then stored in dark, warm place for several days. Have students draw spores after observation with hand lens and microscope.

KEY WORDS

spores
mold

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
b. Cellular	When a single celled organism divides (fission), it produces offspring (daughter cells) identical to itself.

MATERIALS

ACTIVITIES

If the question arises, you may wish to discuss the "need" for fission. Aside from its reproductive function, it increases the ratio of cell membrane to cell volume. Review the importance of the membrane in regulating the passage of materials into and out of the cell.

A hypothetical species of ameba (Ameba reproductos superfastus) will grow to maximum size and undergo fission (under ideal conditions) in 3 min.

One of these ameba is placed in a tank (assuming ideal conditions) and through growth and division fills the tank with ameba in one hour. If you had started with two ameba, how long would it have taken them to fill the tank?

Dramatize this. Most common first answer--one half hour. Mislead a little more; ask "What about geometric progressions?" Some will then answer--15 min. Correct answer, of course, is 57 min. This seemingly nonsensical activity can lead to discussion of actual reproductive potential of microorganisms.

KEY WORDS

fission
daughter cells

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Mitosis is a process of asexual reproduction at the cellular level (nuclear replication).

To identify the changes within the nucleus during mitosis.

Mitosis involves the doubling of the chromosomes (hereditary material) and the very exact division of this material to two resulting daughter cells.

The two new cells have the same hereditary material (blue prints) as the original cell.

MATERIALS

prepared slides of onion root tip

For each student

pipe cleaners
paper diagram

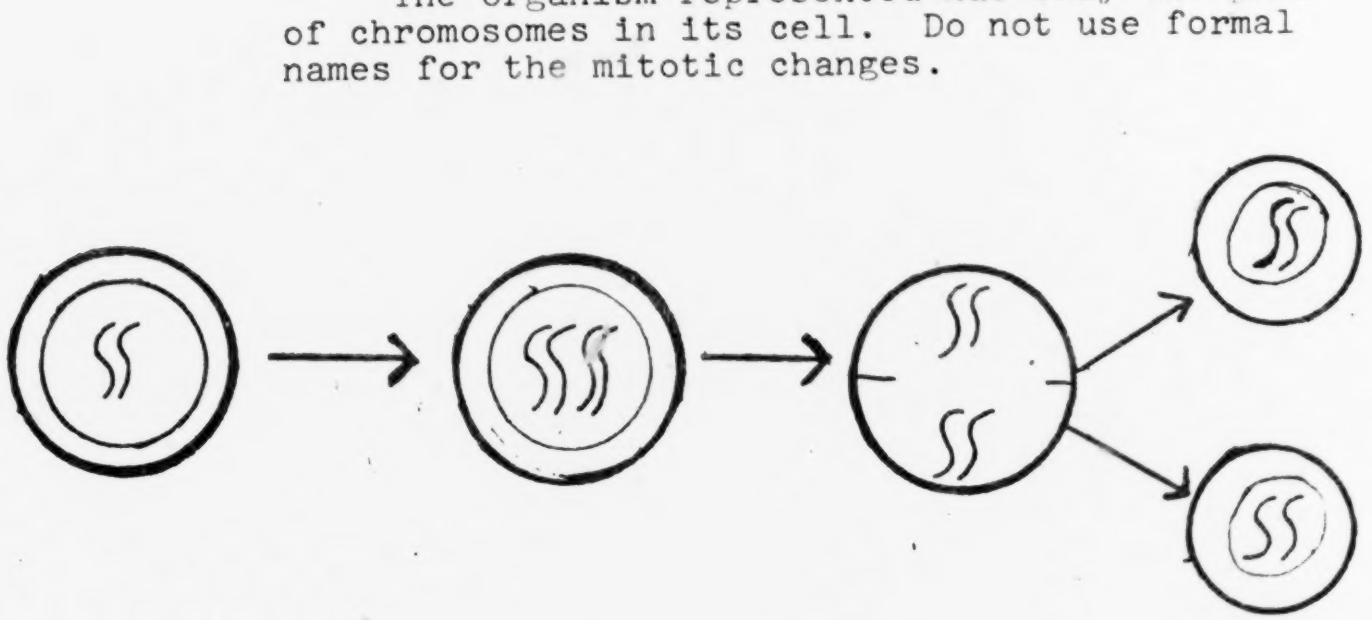
ACTIVITIES

Have pupils observe a prepared slide of mitosis in the onion root. Emphasize that each daughter cell gets identical number and kinds of chromosomes.

Demonstrate a simplified model of mitosis with the outline diagram below. Each pupil should have a blank copy of the diagram together with 14 pipe cleaners.

Project a transparency of the diagram so that students may follow procedures by placing "chromosomes" in the same pattern.

The organism represented has only one pair of chromosomes in its cell. Do not use formal names for the mitotic changes.



Cell at maximum size with chromosomes lined up

Chromosomes replicated giving two identical sets

One pair of chromosomes moves to each end of cell

Two daughter cells produced.

KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Mitosis is also involved in the growth and repair of cells.

Regeneration (regrowth of tissue) may occur in simple cells.

To observe the process of regeneration (regrowth of tissue) in simple cells.

MATERIALS

planaria
razor blade

ACTIVITIES

Discuss and illustrate regeneration in starfish and planaria.

Put individual planaria in individual Syracuse dishes with a little water. With a sharp razor blade cut some worms in half and some in thirds. Make some of the cuts straight across and some diagonally. Cover the dishes by stacking them, putting an empty dish on the top.

Inspect them daily. Some regeneration should be evident within 48 hours. The back half should develop a new front half, and the front half a new back half. The middle third of those cut in thirds should develop new anterior and posterior ends. This is true reproduction, since in time one worm becomes two or three, depending on how the cuts have been made.

KEY WORDS

regeneration

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Sexual	Offspring produced from the union of two parent cells are said to have been reproduced sexually.
a. Fertilization	The union of cells in sexual reproduction is called fertilization and the cell produced is called a zygote. The parent cells which form zygotes are called gametes. The offspring produced in sexual reproduction are not identical to either parent, but show characteristics of both. In flowering plants the male part of the flower, stamen-(anther) produces the male gamete pollen (sperm). The female part, the pistil-(ovule) produces the female gamete (the egg).

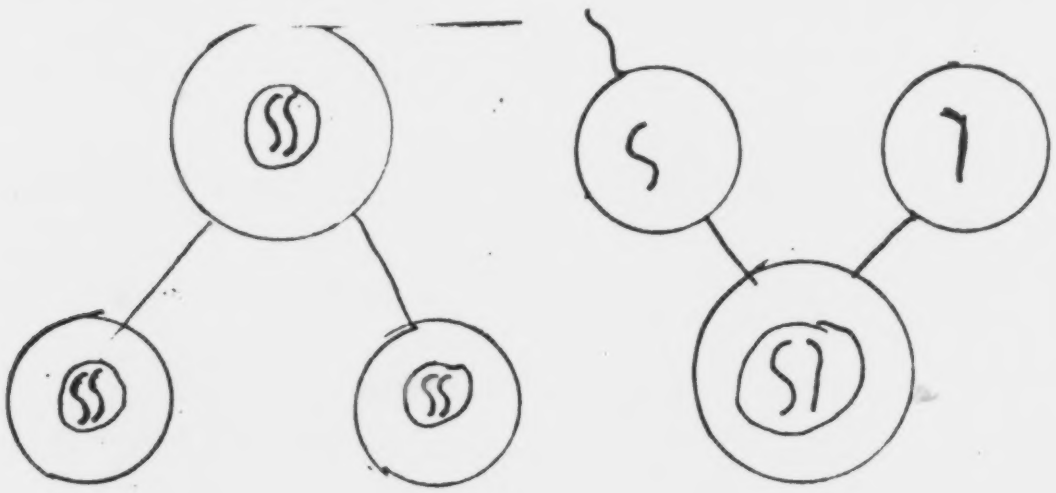
MATERIALS

ACTIVITIES

Compare sexual reproduction with asexual.

This may best be done by simplified diagram models.

Asexual (one parent) Sexual (two parents)



Introduce the terms fertilization, gamete and zygote.

Relate these to the flower structures which were studied in the plant unit.

Male gamete - in pollen
(sperm)

Female gamete - egg in ovule

Zygote - becomes seed (+ stored food)

KEY WORDS

gamete
sperm
egg
zygote
fertilization

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
b. Meiosis	Sexual reproduction provides a chance for greater variety in offspring than does asexual reproduction. Reduction division (meiosis) must take place in the formation of gametes in order to maintain a normal chromosome number (for a species) in each generation.
c. Animals	In animals the gametes are produced in sex organs called gonads - testes in the male ovaries in the female. The pattern of sexual reproduction is similar in most animals but there are specialized adaptations.

MATERIALS

ACTIVITIES

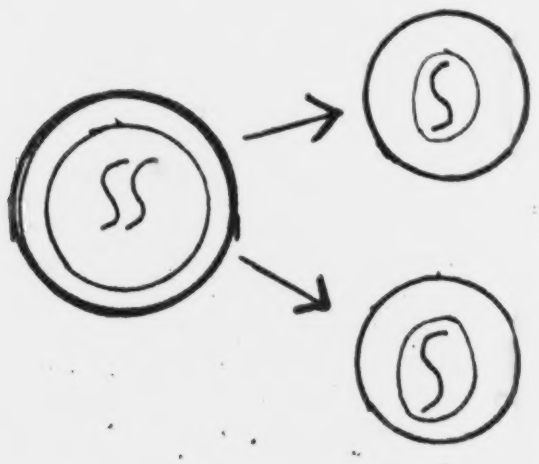
Transparency
Pipe Cleaners

Discuss plants which must be propagated vegetatively in order to retain characteristics. eg. seeds from spreading Japanese Yews produce upright yews spreading yews are propagated as grafts.

Present meiosis as a simple reduction division.

Again give students pipe cleaners and blank chart and have them follow your explanation on the overhead projector.

In meiosis one cell divides producting cells, which each have one half of the number of chromosomes found in the original cell.



KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Animals which live in water generally have external fertilization and development.

Most land animals have internal fertilization.

MATERIALS

live male frog
frog ringer's
medicine dropper
slides
cover slips
dish
microscope
methylene blue

ACTIVITIES

Frog sperm

a. Examination of live sperm. Remove the testes from a freshly killed male frog. Mince them finely in about 15 cc. of Ringer's solution or aquarium water in a Syracuse dish. The milky material that comes from the testes contains millions of sperm. With a dropper, put a little of this material in the center of a clean microscope slide. Add a cover slip and examine under the low and high power of the microscope.

It is necessary to subdue the light by closing the diaphragm in order to see the tiny sperm cells. Their movement may make it difficult to focus sharply on them. Details of their structure can be seen more clearly if the cover slip is removed and a drop of dilute methylene blue stain added. However, this will kill the cells.

preserved chicken ovaries

Show chicken ovaries-preserved mammal gonads.

dissecting equipment
small mammal preserved

A preserved rat, field mouse or other small mammal can be used to show the structure of the gamete-producing organs and their relations to other organs.

Place the animal on a dissecting tray with its ventral side uppermost. With scissors make an incision through the body wall extending from the anus to a point midway between the front legs. Make incisions from the ends of this one to the bases of the front and hind legs. Pin back the body wall flaps, exposing the contents of the abdominal cavity.

Snip the large intestine at the anus and cut the esophagus where it enters the stomach. Detach the mesentery and remove the intestinal tract.

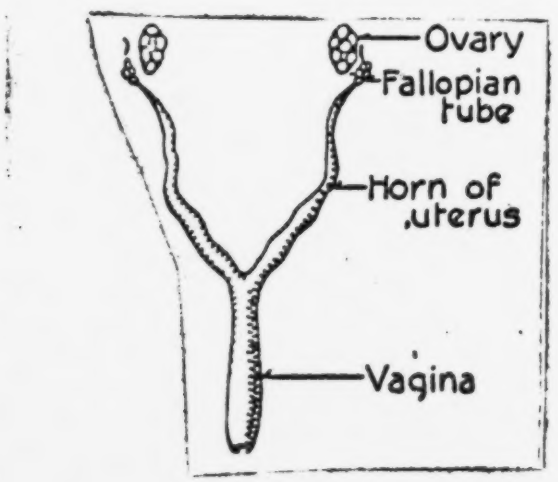
REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

In a female, the ovaries will be seen as whitish structures just posterior to the kidneys. The oviducts, uterus and vagina will be seen as a Y-shaped tube leading from the ovaries. If there are bulges in the uterus, open them and look for embryos. Small discolored areas at intervals are placental scars; they indicate where her last embryos were attached to the uterine wall.



REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Plant seeds contain stored food to support the young plant until it is able to produce its own.

Animals with external development have stored food in the egg for nourishment.

MATERIALS

fertilized frog eggs
large mouth gallon jars
pond water
water plants
test tubes - corks
magnifer
dissecting microscope

ACTIVITIES

Frog development

Masses of frog eggs can be collected from ponds in the spring. Those that have been fertilized will be found with the black side of the egg up. Those with the white side up are either dead or have not been fertilized.

Divide the eggs into clumps of about 50 eggs, discarding, where possible, dead or unfertilized eggs. Put each clump into a large-mouth gallon jar about three-quarters full of pond or aquarium water with a few water plants. This will provide the water and surface area necessary to supply the needed amounts of oxygen, and the plants will remove waste carbon dioxide. Each day remove an egg and examine under a tripod magnifier.

Pupils can individually maintain developing eggs in test tubes. Place a single live fertilized egg in a test tube about two-thirds full of pond or aquarium water. Each day have pupils cork the tube, turn it on its side and examine the developing egg under a tripod magnifier or dissecting microscope. Drawings can be made daily to keep a record of the developing embryo. After examination, the tubes should be unstoppered and placed in racks until the next day's examination.

Key Words

fertilized
embryo

After hatching, the tadpoles may be fed bits of boiled lettuce leaf. Feed in the morning, and remove any uneaten food at the end of the day so that the tadpoles are not killed by the decay products of the uneaten food.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

In animals with external fertilization, large numbers of sperm and eggs are produced.

Compare reproduction and development in vertebrates.

To list the differences in development among the three groups of mammals. Egg layers, Marsupials and Placental.

MATERIALS

ACTIVITIES

Discuss the reason for the great number of sperm produced compared to eggs.

Chicken development

2 dozen fertilized chicken eggs (if the teacher wishes enough for observation for full 21 days to hatching. Otherwise fewer will be needed.

incubator (see diagham)

physiological salt solution

finger bowls

Incubate some fertile chicken eggs and break them open at intervals to observe the development of the chicken. Be sure the eggs are fertile. Many of those obtained in grocery stores are not.

If an incubator cannot be obtained for the laboratory or borrowed, a satisfactory one can be made as shown in diagram. The temperature of the incubator should be a constant 103°F. This is obtained by adjusting the thermostat of most incubators. In the one shown in the diagram the temperature maintained can be varied by changing the wattage of the light bulbs, or by adding or removing some of the paper used for insulation. Be sure the thermometer is at the same level in the incubator as the eggs will be, for differences of as much as 10°F may be found in the incubator.

Put a pan of water in the incubator with the eggs to maintain a moist atmosphere. Eggs should be turned twice a day to prevent the membranes from adhering to the shell. It is advisable to put a pencil mark on the surface of the shells to know when they have been turned 180°.

Eggs can be removed for examination daily beginning with the first day. When the egg is removed, be sure that it is held in the same position that it was in the incubator so that the embryo will be on top, floating on the heavier yolk.

Crack the egg gently on the edge of a finger bowl half-full of physiological saline solution (9 gm. of iodine-free sodium chloride dissolved in 1,000 cc. of water).

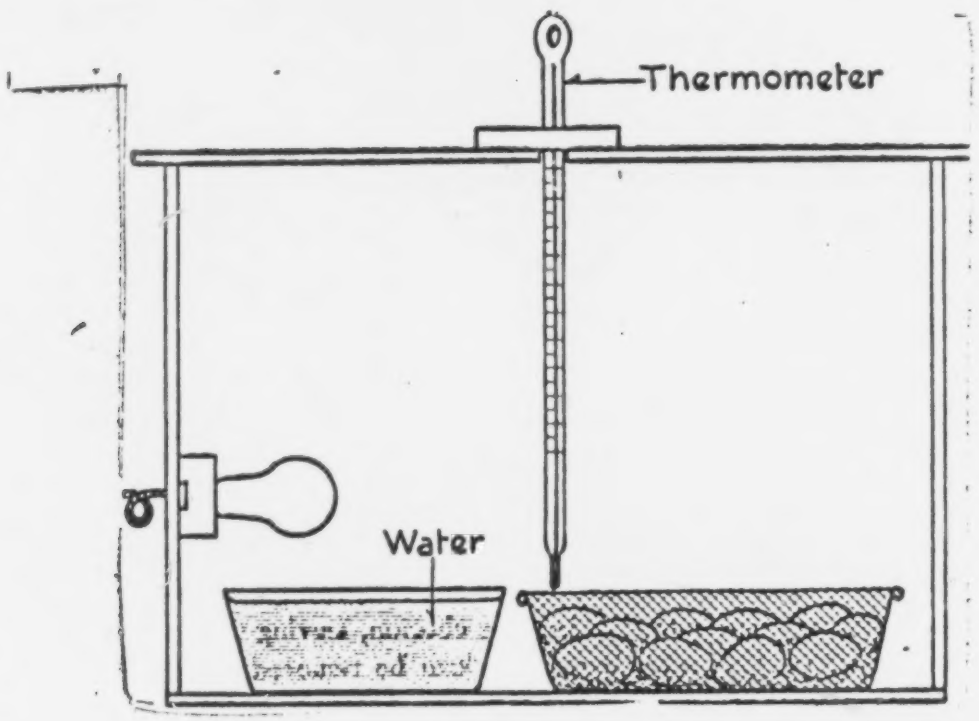
A 3-day embryo shows the heart already beating. It will remain beating for half an hour or so if the saline solution has been warmed to approximately 103°F before the egg was put into it.

REFERENCE OUTLINE ØBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

A 4-day embryo will show the beating heart and the beginnings of embryonic membranes.



REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
	Animals with internal development (placental mammals) obtain nourishment from the mother.
C. Human Reproduction	
1. Structures	
(a) Male	The human male has paired testes in an outpocketing called the scrotum. Ducts conduct the sperm cells out of the body. Glands contribute fluid into these ducts; this fluid helps the sperm cells to survive.
(b) Female	The human female has a pair of ovaries in the lower part of the abdominal area. The eggs are given off from the ovary during a process called ovulation. During ovulation, the eggs move into tubes called the Fallopian tubes (oviducts). Fertilization usually occurs here. The Fallopian tubes lead into a structure called the uterus. The uterus is connected at its lower end to a tube called the vagina.

MATERIALS

ACTIVITIES

Mammal Embryonic Development

dissecting equipment

The uterus from a pregnant pig, which can be obtained from supply houses, makes an excellent demonstration specimen to show the relationships of the uterus, embryonic membranes and embryo.

Carefully cut through the uterine wall and remove an embryo complete with amnion and chorion. Remove the chorion, leaving the embryo in the amnionic sac. Finally the amnion can be removed, revealing the embryo and showing the umbilical cord connecting the embryonic membranes to the embryo. Be sure students see the release of fluid when the amnion is cut.

One of the outstanding things this demonstration can show is that the embryonic membranes are about as massive as the embryo itself.

The embryo and its membranes can be mounted on a glass plate and preserved in a jar of 10 percent formalin.

Key Words

placenta
ovaries
Fallopian tube
testes

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
(1.) Menstrual Cycle	A mature female usually produces one egg a month until about middle age (menopause). This monthly development of an egg is known as menstrual cycle. The menstrual cycle involves the pituitary gland, the ovary, and the uterus. In this cycle, hormones help to prepare the uterus for an egg. If the egg is unfertilized, the uterine liming will be shed in a process known as menstruation.

MATERIALS

ACTIVITIES

Discuss the feed back mechanisms in the menstrual cycle and the role of these hormones in maintaining homeostasis.

Chemical Messenger	From	To	Causes
FSH	Pituitary	Ovary	Causes development of a follicle.
Estrogen	Follicle cells in ovary	Pituitary	Stops FSH production Causes production of LH
		Uterus	Development of blood vessels
LH	Pituitary gland	Follicle	Causes follicle to burst and release egg cell
			Causes development of corpus leteum
Progre-terone	Corpus luteum	Uterus	Results in maintenance of glands and blood vessels

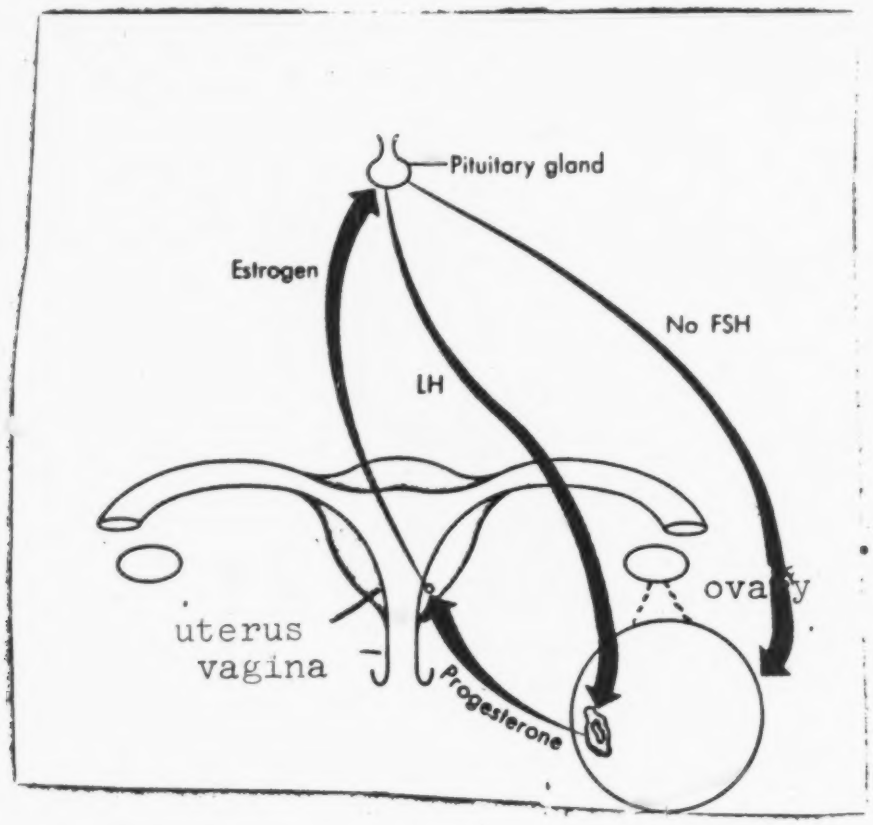
REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
	If the egg is fertilized, it becomes implanted in the uterine wall and develops there.
2. Development of the Embryo	The fertilized human egg cell divides rapidly by mitosis, producing thousands of cells.
	As the embryo develops, it forms three layers of cells which eventually specialize and become tissues, organs, and organ-systems.
	The developing embryo receives its oxygen and nourishment through an umbilical cord, which leads from the embryo to the placenta (a place of attachment for the umbilical cord to the uterus.)
	The placenta is the organ through which the blood of the embryo and mother exchange gasses (O_2 for CO_2) nutrients. From the mother) and waste products (from the embryo).

MATERIALS

ACTIVITIES

Discuss how the homeostasis is changed if fertilization occurs.

This may be illustrated by a diagram such as this.



Key Words

umbilical cord

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
3. Postnatal Care	After a period of internal development (gestation) of about nine months, the baby is born and with proper care continues to grow to maturity. Growth involves an increase in cell size and number (mitosis). Eventually, deterioration occurs as part of the aging process and finally, death.

MATERIALS

ACTIVITIES

Have the students list a number of animals in order of the amount of care for their young from least to most. Then list the same animals in order to numbers of young produced from most to least.

Ask the students to explain any relationship which they can find.

Homo sapiens have one of the longest periods of maturation, this may be related to the high degree of learned behavior.

UNIT V

GENETICS

UNIT V .. GENETICS

I. Genetics

- A. Introduction
  - 1. Characteristic Traits
- B. Heredity
- C. Principles of Heredity
  - 1. Gregor Mendel
    - a. Probability
  - 2. Dominance
  - 3. Segregation and Recombination
  - 4. Independent Assortment
  - 5. Sex Determination
  - 6. Sex Linkage
- D. Heredity and Environment
- E. Gamete Formation
- F. Modern Genetics
  - 1. DNA
    - a. Location
    - b. Function
    - c. Code
  - 2. Mutations
    - a. Causes
    - b. Results
- G. Application of Genetic Principles

REFERENCE OUTLINE

I. Genetics

A. Introduction

OBJECTIVES AND UNDERSTANDINGS

To recognize the similarities and differences in organisms from generation to generation.

To discover that only some characteristics are inherited.

To recognize the relationship between probability or chance and the study of heredity.

To discover the interaction between heredity and environment.

Teacher's note:
The understanding of genetics depends greatly on the student's ability to imagine and to reason. This is a difficulty in teaching genetics, and it presents a real challenge to the teacher. How can the student be helped through this reasoning process? One valid and effective method is to put the ideas into a fundamental and familiar context.

Many students may be familiar with the idea of inheritance. The appearance of traits that are more or less constant from generation to generation in a family suggests heredity.

Allow the students to start with his own ideas and by asking questions arrive at initial generalizations. The teacher should not judge any idea as right or wrong.

MATERIALS

ACTIVITIES

*Part 1. Do we inherit all of our traits and characteristics? Have each student compile individual lists of traits which they feel were inherited. Indicate that students should list traits down one side of a sheet of paper. Ask some students to suggest a few traits to get the rest of the class started.

*Part 2. From whom do you think you inherited these traits? Indicate that family members should be put across the top of the paper.

Let's add some other people in your family who might have inherited the same characteristics as yours. How can we fill in this chart and what can be learned from it.

The chart will be similar to the one below.

Traits	Individual Characteristics	Like Mother	Like Father	Like Mother's Father	Like Father's Father
Eye color	brown				
Hair color	red				

KEY WORDS

Each student should fill in their own characteristics such as brown or blue eyes in the second column where the relative has the similar characteristic.

*Part 3. Have students look at their completed charts and decide which traits seem to be inherited. (They will probably suggest eye color, hair color, height, weight, shape of nose and ear, etc.)

*Optional - Adopted children may not know their natural parents. Some children may not know their fathers. No child should be placed in an embarassing position in dealing with the topic of genetics and inheritance.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
1. Characteristic traits	Offspring are both similar to and different from their parents. Only some traits are inherited. Even when the same traits are inherited, there are noticeable variations.

MATERIALS

ACTIVITIES

Let's think of a situation in which two people would inherit exactly the same characteristics. The traits of identical twins are examples of such a situation.

Point out that even when the same characteristics are inherited there will be slight, noticeable variations.

Which traits on your chart do not seem to be inherited? Can you explain these? Do you always resemble your parents, grandparents, brother or sister? How can you explain this?

Students should be allowed plenty of time to discuss questions and should be encouraged to challenge each other's statements.

This general discussion and activity should lead to the development of concepts concerning traits which are inherited and those which are not.

KEY WORDS

trait
characteristic
inherited

REFERENCE OUTLINE

B. Heredity

OBJECTIVES AND UNDERSTANDINGS

Heredity is the passing of traits from parents to offspring.

The study of the passing on of hereditary material from generation to generation is called genetics.

MATERIALS

PTC paper

beads
string

KEY WORDS

offspring
heredity
generation

ACTIVITIES

Inheritance of Taste Ability

It is difficult to find many human traits that are inherited as a result of the action of a single pair of genes and that are not affected by environment. One trait that apparently fits these specifications is the ability to taste a harmless substance called phenylthiocarbamide.

Papers that have been soaked in this substance are called PTC papers. Taster papers can be obtained from the American Genetics Association, 1507 M Street NW., Washington 5, D.C. at a very nominal price.

About 7 out of 10 persons, on chewing up a bit of the paper, will taste a very bitter substance. Some will taste it as sweet, salt or sour. The remaining 3 of 10 will taste nothing but the paper that has been impregnated with the substance.

Pupils are usually interested in taking bits of the paper home to find out if their parents and the members of the family have the ability to taste the substance. Interesting pedigree charts for this trait can be constructed.

A string of pearls or popit beads may be used as a simple model of a chromosome. Each pearl or bead represents a gene, and the row of beads represent the chromosome.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
C. Principles of heredity	Scientists can tell a great deal about what might happen in heredity or what probably will happen.
1. Gregor Mendel	Gregor Mendel, often called the father of genetics, discovered some principles governing the way traits are inherited. Mendel used the following approach: Used many similar parents to get large numbers of offspring Observed and counted each type of offspring in every operation Studied only one trait at a time
a. Probability	Understanding some rules and assumptions of probability or chance will help to teach the principles of heredity.

MATERIALS

coins
two decks of cards
pair of dice
roulette wheel or
any additional,
unexpected motivational material

ACTIVITIES

A. Understanding Chance (Biology Casino)

1. The students may work in pairs. (Keep a record of all information.)

2. Take turns flipping a coin and calling the flip - heads or tails.

3. Record your calls.

4. Do this for one minute.

Did you guess the flip correctly each time?

If not, why?

What do you think would be your chances of guessing correctly?

B. Shuffle a deck of cards and ask a student to choose one card.

1. Each student should write down what suit the card is. How many suits are there in a deck of cards?

2. Replace the card in the deck, reshuffle, and select another card.

KEY WORDS

probability
chance

3. Did the card selected by chance the first time have any influence on the suit of the card selected the second time? Repeat as often as necessary to get a general agreement or answer to the question.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

To understand that the occurrence of one chance event does not affect results of later occurrences of the same chance event. Each event is independent of preceding similar events.

MATERIALS

ACTIVITIES

C. See how good you are at guessing the number that has been rolled on the die (singular for dice).

Write down your guess.

What were some of the guesses made?

How many different kinds of guesses could have been made with one die?

What are your chances of guessing correctly?

D. Let's now see what else you can discover about chance or probability. Again, as one of your classmates draws a card from a deck that has been shuffled and fanned, decide what the chances are that it will be of any one suit. In other words, what is the probability that it is a club, diamond, heart, or spade? Still without looking at the card, now tell what the chances are that it will be any one card in that suit? (You will have to recall how many cards there are in a suit.) Now let's ask still a third question before we look at the card. What are the chances that it will be any one card in the deck, say, the ace of hearts?

KEY WORDS

occurrence

REFERENCE OUTLINE OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

1. Fill in these three chances in the table after draw 1. Now look at the card.

Draw number	Separate event (suit chance)	Separate event (value chance)	Combined event (suit and value chance)
1			
2			
3			
4			

2. Let's do the same thing again, but this time use only the 13 hearts in the deck. Set aside the other cards for a while. What are the chances that the card you now draw will be a heart? How about the chances that the card will be a queen? Now what are the chances that it will be both a queen and a heart at the same time, or in other words, the queen of hearts? Record these chances on the table after draw. Then look at the card.

KEY WORDS

3. Let's take a third set of cards. Use all the black cards in the deck. What suits are we now using? What is the chance that the card you draw will be a club? What about the chance that it will be a nine? How about the probability that this card is a nine of clubs? Record these chances after draw 3 on the table. Look at the card.

4. This time add another set of 13 diamonds to a complete deck. How many cards have been shuffled? What are the chances that you will pick a diamond?

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

The laws of chance (probability) can be applied to the inheritance of traits.

MATERIALS

ACTIVITIES

5. What are the chances you will pick a five from a full deck of cards?

   What are the chances you will pick a five of hearts?

   Remember how many hearts are in a deck.

   Record these chances after draw 4 on the table. (Note: It is good to record the chances as 4 out of 52 where there are 4 of each value in a deck of 52, and then to reduce it to 1 out of 13.)

   Look at the card. Were most of the draws guessed incorrectly? Why?

   Look at the results of your 4 different draws. What do you notice about the numbers in column 2 and 3 as compared with the number in column 4?

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

The laws of probability are applied to living things as well as to non-living.

Genes in the gamete carries a characteristic from generation to generation.

Genes occur in pairs.

A characteristic may be hidden by another characteristic in a generation.

MATERIALS

ACTIVITIES

Use a chart similar to the one below to show crosses between a red four o'clock flower and a white four o'clock flower. (Punnett squares may also be used.)

What do you have to assume to expect to get all pink offspring from red and white four o'clock flowers?

PARENTS		OFFSPRING
Red	White	Pink
R	W	RW

	W	W
R	RW	RW
R	RW	RW

With a similar chart or Punnett square, cross pink-flowered offspring.

What do you have to assume to expect to get some red, white, and pink flowered-offspring?

PARENTS		OFFSPRING		
Pink	Pink	Red	White	Pink

	R	W
R	RR	RW
W	RW	WW

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Dominance*	For each trait, there are at least two genes which control its inheritance. Most human traits, including eye and natural hair color are controlled by more than one pair of genes. If two opposite genes for a characteristic occur in a zygote, one gene may dominate the other. A dominant trait appears in children only when the trait is present in one or both parents. The gene being dominated is called the recessive gene. Recessive traits tend to skip generations without appearing because the recessive genes may be masked by dominant genes. A person with two similar genes for a trait is said to be pure or homozygous. A person with two unlike genes for a trait is said to be hybrid or heterozygous. At times, neither gene will dominate.

* Punnett square, charts, and other diagrammatic methods should be used to explain dominance.

MATERIALS

ACTIVITIES

The teacher may wish to study blood groups at this time as an activity.

Full safety precautions must be taken (see Rules on Safety in the Classroom and Laboratory).

Mature volunteers only should be permitted to participate in this activity. The findings can be shared with other class members.

Approximate Blood Types of Different Racial and National Groups				
	O	A	B	AB
U.S.A.—white	45%	41%	10%	4%
U.S.A.—Negro	50%	26%	21%	4%
North American Indian	91%	8%	1%	0%
Hawaiian	36%	61%	2%	1%
Japanese	31%	39%	22%	9%
Chinese	30%	25%	35%	10%
Swedish	38%	47%	10%	5%
Our biology class	__%	__%	__%	__%

KEY WORDS

dominant
recessive
hybrid
recombination
gene
zygote
homozygous

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
3. Segregation and recombination	When two hybrid individuals are crossed, the recessive genes may segregate or separate out from the dominant genes. At fertilization there is a chance for the recessive genes to recombine (come together again and appear in some of the offspring). For example, blue-eyed children may be born to brown-eyed parents.
4. Independent assortment	When more than one trait is involved in a cross, for example, height and color, each character behaves as a unit and is inherited independently of each other.
5. Sex determination	Sex is determined at fertilization. There are 46 chromosomes in most humans, two are called sex chromosomes. The larger of the sex chromosomes is designated as the X chromosome. The smaller sex chromosome is called the Y chromosome. In females there are two X chromosomes and in males there is normally an X and a Y chromosome.
6. Sex linkage	Genes found on the X chromosome are called sex linked genes. Color blindness, hemophilia, and baldness are said to be sex linked traits, meaning that they are inherited together with the sex of an individual.

MATERIALS

ACTIVITIES

Discuss the discovery of sex determination in fruit flies.

Standard color blindness test charts may be appropriately used at this point.

Study the pedigree of the descendents of Queen Victoria to illustrate the inheritance of hemophelia.

Use this pedigree as examples of sex-linked inheritance. Point out the genetic problems of marriage between relatives.

Discuss the role of this gene in the history of Europe.

KEY WORDS

fertilization
cross

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
D. Heredity versus environment	Genes do not always act alone. The environment has a significant effect on the action of genes. Every person is a product of heredity and environment.

MATERIALS

ACTIVITIES

If possible, locate a set of identical twins. Have them visit your class and explain how they believe they are similar and different in physical and personality traits. (Students from your class may wish to interview various twins in the school. Have them report on their information.)

Discuss the fact that, for the present, little can be done about one's heredity, but a great deal can be done with the environment.

Investigate the reasons for the change in individual's height between this generation and the last. Why do people who migrate to the United States, on the average, have children who are taller than children in "the old country"?

Interaction of Heredity and Environment

tall and dwarf varieties of peas

small plant pots or juice cans

Obtain seeds of tall and dwarf varieties of peas and plant some of each. After the plants have grown enough to show these characteristics, cover some of the dwarf plants to shut out the light. Empty juice cans from which the tops have been cut are useful for this purpose. In a short time the absence of light will cause the dwarf plants to grow tall, in some cases taller than the tall plants exposed to light. In this way students can see that environment may influence inherited characteristics.

Interaction of Heredity and Environment

hybrid corn or sorghum seeds

plant pots

Plant 100 seeds from hybrid corn or sorghum containing the recessive gene for albinism and keep them in a dark place until the seeds are 2 or 3 inches high. They will all lack chlorophyll. Then bring them into the light, and chlorophyll will develop in approximately 75 percent of the seedlings. It can thus be shown that both heredity and environment are responsible for the organism that finally develops.

KEY WORDS

REFERENCE OUTLINE

E. Gamete formation

OBJECTIVES AND UNDERSTANDINGS

The cells in the gonads ripen under the influence of hormones. They undergo division which ultimately result in the formation gametes.

Gametes are sex cells.

Fertilization occurs when a gamete (sperm) from the male unites with a gamete (egg) from the female.

The resulting organism (zygote) has a set of chromosomes (containing genes) from the father and from the mother.

It is through the transmitting of hereditary material from generation to generation that a species maintains its own distinctive characteristics.

Gametes have half the number of chromosomes (and DNA) as other cells.

The number of chromosomes is definite for each species.

The usual number of chromosomes in a human is 46. (23 from the male gamete and 23 from the female gamete.)

The number of chromosomes among species varies widely, from as few as two in some worms to as many as 1600 in some protozoans.

The number of chromosomes that is characteristic of a species is not really important.

The important factor is the nature of the hereditary material in these chromosomes passed on by the parents in the development of each new organism.

MATERIALS

ACTIVITIES

Laws of Chance in Heredity

This exercise will demonstrate the segregation of chromosomes when two organisms hybrid for one trait are crossed.

Allow pupils to work in pairs.

Let a brown bean represent a gamete carrying a gene for the character brown which is assumed to be dominant over the gene for white. The white beans represent gametes carrying a gene for the character white.

Place 25 brown and 25 white beans in each of two paper cups. One cup of beans represents 50 eggs and the other 50 sperm from individuals hybrid for this trait.

With closed eyes, have one student of the pair pick a bean from each cup and put them together to represent the union of two gametes to produce a zygote. Have the other student keep a tally. Replace the beans in the proper cups so that the chances for matching or mismatching will be the same for subsequent draws. Continue until 25 pairs have been matched.

KEY WORDS

gamete
zygote
gene
chromosomes

Letting "B" represent a gene for brown and "w" represent a gene for white, complete the record of the results obtained in a chart similar to the one below. Compile the results of all groups in the class and record the totals in the line marked "class total." The purpose of this is to provide a larger number which will be expected to more closely approximate the theoretical 25 percent BB, 50 percent Bw, 25 percent ww.

RESULTS	NO. OF *bb*	PERCENT OF *bb*	NO. OF *bw*	PERCENT OF *bw*	NO. OF *ww*	PERCENT OF *ww*
Your results						
Class total						

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
F. Modern genetics*	
1. DNA	The chemical that is the hereditary material is called DNA.
a. Location	DNA is usually found in the nucleus, although it may also be found in the cytoplasm of some simple organisms such as blue-green algae.
b. Function	DNA is the chemical that determines what you are. The DNA molecule contains the genetic code.
c. Code	This genetic code is spelled out by the arrangement of four substances found in DNA: a. Adenine (A) b. Guanine (G) c. Thymine (T) d. Cytosine (C) These substances pair as follows: A with T G with C There is almost no end to the number of ways in which these pairs can be arranged, one after the other.

*The DNA code is not meaningful to pupils although they should be aware that a "code" exists.

MATERIALS

16 marbles, beads, etc.
4 red
4 blue
4 green
4 yellow

ACTIVITIES

Probabilities in the Genetic Code

The students may work individually or in small groups (2 or 4).

Place the marbles in a row. Put them in an arrangement of red-blue-green-yellow, red-blue-green-yellow, red-blue-green-yellow, red-blue-green-yellow.

Now rearrange the marbles. Make only one change. (For example, you might change the order of the first group to an arrangement of blue-red-green-yellow.)

Continue to change the order of the marbles. How many patterns can you work out?

The marbles represent only four colors, but there is no end to the varied patterns that could be worked out with billions of marbles.

KEY WORDS

nucleus
cytoplasm
genetic code

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Each gene has a different code. (That is, the order of AT, GC, CG, TA varies from gene to gene.) Therefore, each gene can pass along its own special trait.

The substances of the DNA molecule are the same in all living things.

The differences among living things result from the way in which these substances or pairs are arranged, as well as from the ratio of the number of AT (or TA) to GC (or CG).

The order and ratio of pairs makes all the difference between a flea and a dog, a cat and a mouse, a rose and a cactus, or a man and other forms of life.

The type of protein present in living things depends upon the type of DNA which controls its formation.

MATERIALS

ACTIVITIES

Discuss the difficulties in transplating organ parts since different DNA's were involved in building the proteins of those organs.

What is meant by compatibility of tissues and organs?

Students may wish to do reports on recent progress made in the area of transplantation of human parts.

Discuss current progress made toward a better understanding of DNA, RNA, and genes.

Discuss the possible relationship of DNA and diseases such as cancer.

KEY WORDS

gene
ratio

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
2. Mutations	A change in one's heredity is known as mutation.
	Most mutations are harmful.
a. Causes	Mutations are caused when changes occur in DNA.
	Mutations may result from physical or chemical damage to a gene or chromosome.
	Some of the causes of damage may be x-rays and other radiation, chemicals, such as LSD, and an increase in heat.
	In the environment, one is subjected to radiation all of the time.
	The normal level of radiation brings about "spontaneous mutations", but at a low rate.
	One of the dangers of setting off nuclear devices is that the radiation level in our natural environment would be greatly increased.
	An increase in the radiation level brings with it an increase in the mutation rate.
b. Results	There are many kinds of mutations. Color, size, and shape may be changed by mutations.

MATERIALS

ACTIVITIES

KEY WORDS

mutation

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Usually mutations are recessive traits hidden by normal genes for dominant traits.

Cattle born without horns, dogs born without tails and oranges without seeds are examples of mutations.

Examples of mutations in man:

Down's disease is a form of mental deficiency, which is accompanied by a characteristic facial appearance.

Sickle cell anemia is a blood disease. It was called sickle-cell anemia because the red blood cells from patients suffering from this disease often had an abnormal, sickle shape.

An albino, a person who has albinism does not have any color pigment in his hair, skin, or pupils of his eyes.

PKU is a condition in which there is extreme mental deficiency. This condition, like most mutations, is transmitted by a recessive gene.

MATERIALS

ACTIVITIES

List a number of human malfunctions possibly resulting from mutations.

KEY WORDS

albino

REFERENCE OUTLINE

G. Applications of genetic principles

OBJECTIVES AND UNDERSTANDINGS

The practical application of genetic principles to plants and animals is known as breeding.

Some of the methods of breeders are:

inbreeding - crossing close relatives, such as is done with race horses.

hybridizing - crossing distant relatives, such as horse and donkey.

vegetative propagation - usually asexual reproduction, such as grafting to keep desirable qualities in order to obtain more seedless fruits.

Many new varieties of fruits have been produced.

California navel orange, pink grapefruit, nectarine and a variety of plums, cherries, grapes and strawberries are examples.

MATERIALS

ACTIVITIES

Grafting. Some plants will not form roots from stem cuttings. In this case it is necessary to graft the stem cutting, or plant it in the stem of a similar or closely related plant. This is the common way of reproducing most fruit trees and many types of roses.

An illustration of grafting that produces quick results in the laboratory can be done by joining a potato and a tomato plant. This is known as an in-arch graft, and is somewhat different from the simple stem graft.

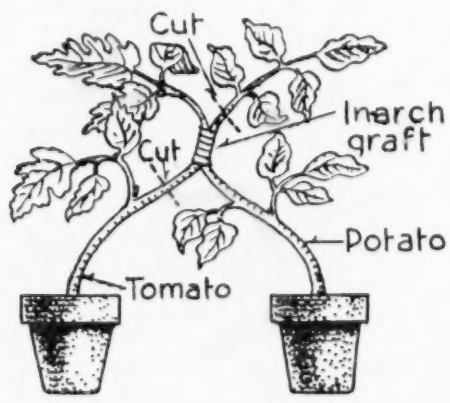
Grow a potato plant from a piece of tuber and a tomato plant in two pots side by side, or together in a large pot. When the plants are each about 10 inches tall, bring the two stems together. Where they will touch, shave the outer portion of each stem for a distance of about 2 inches until several vascular bundles of each stem are exposed. Bring the cut surfaces together, as shown in diagram and carefully tie them together with soft cord or raffia. Seal with paraffin or grafting wax.

The two plants should grow together in about 4 weeks. If so, cut off the tomato stem below the graft and the potato stem above the graft. You now have a plant with potato roots and the leaves and stems of a tomato. If the plant can be kept growing, it is possible to produce potatoes below the ground and tomatoes above the ground on the same plant.

KEY WORDS

inbreeding
hybridizing
vegetative
propagation

This graft is possible because the potato and tomato plants are very closely related.



UNIT VI

THE HISTORY OF LIFE

UNIT VI

THE HISTORY OF LIFE

I. The Origin of Life

II. Changes in Life

A. Evidence of evolution

B. Results of evolution

C. Theories of evolution

1. Use and disuse

2. Natural selection

3. Modern theory

D. Evolution of Man

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
Evolution	The term "evolution" refers to the slow changes that have occurred in living things through the years. The organisms which have appeared more recently on earth are generally more complicated than earlier ones.
I. Origin of life	Man cannot be sure how life came about on earth.

MATERIALS

ACTIVITIES

Teacher's note: The definition of evolution, as stated, is as much a "fact" as is the concept of "gravity". The fact that living organisms have changed with time is substantiated by considerable evidence. This change in organisms through time is called evolution. Of course, the details of how changes have occurred are frequently obscure.

A Russian scientist, I. A. Oparin, reported a theory on the beginnings of life. Recent experiments tend to support the idea that organic molecules can arise from an "inorganic soup" given the supposed conditions in primordial earth.

KEY WORDS

evolution
(as change)

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
II. Changes in life	It is believed that all life evolved from the first forms of life. Therefore, all life may be considered related.
A. Evidence of evolution	Fossils (the remains of living things or evidence of their existence) support the concept that all living things change with time (theory of evolution). Fossils also show that the climate and land surface have changed over the ages. Some types of fossil forms are: . coal . oil . petrified organisms . frozen organisms . molds

MATERIALS

ACTIVITIES

Have students construct a time line for the history of the earth.

	Years-Before Present
Origin of the earth	5-6 Billion
First Life	1.6 Billion
First land plants and insects	380 Million
First amphibians	280 Million
First flowering plants	160 Million
First mammals	100 Million
First horse (Eohippus)	58 Million
First true men	1.75 Million
Modern horse	1 Million
First Homo sapiens	50 Thousand

Possible time scale:
7 days = 5 Billion years
24 hours =5 Billion Years
1 mile = 5 Billion Years
365 days = 5 Billion Years
12 inches=5 Billion Years
1 hour = 5 Billion Years

Key Words

fossil
petrified

Review the geologic time scale as covered in 8th grade.

Discuss fossil formation. Have students bring in any fossils they may have.

Display and pass around examples of fossils.

Possible short reports on one of the geologic periods by students.

Discuss the extinction of various life forms and possible causes. Dinosaurs', Passenger Pidgeon etc.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
B. Results of evolution	If all living things are related, then the more closely related two organisms are, the more they should resemble each other. Some of these resemblances may be seen by: . comparing skeletons . comparing embryos . comparing blood . examining vestigal structures (structures - that are present but have no apparent value)

MATERIALS

preserved materials from vertebrates dissected during the year

seed beds
variety of monocot and dicot seeds

KEY WORDS

vestigal
embryo

ACTIVITIES

Comparative Anatomy

Important indirect evidence for the support of evolution comes from the anatomical study of similar forms. Several series of dissections can easily be done.

a. Forelimbs - Dissect out the forelimb of a fish, frog, turtle pigeon, bat and rat. Mount these on a large board with labels. Connect corresponding structures with thick white tape of painted lines.

b. Hearts - The hearts of the above organisms can be dissected out to show a series progressing from the two-chambered heart of the fish to the 4-chambered one of the pigeon, bat and rat. Cut the hearts in half longitudinally to expose the auricles and centricles. Fasten all hearts, in order from 2 to 4 chambered, to a large glass plate with string and mount in a jar of 10 percent formalin.

c. Brains - The brains of the above organisms provide an interesting series of dissection specimens. Progressing from fish to rat, the cerebrum constitutes an increasingly larger proportion of the entire brain. These specimens can be mounted like the heart, either whole or bisected longitudinally.

Comparative Embryology

Similarities in appearance of early-stage embryos of all vertebrates has long been noted and pointed out to students of evolution. The same thing can be demonstrated in seedlings.

In a cigarbox or seed flat, plant rows of fast-growing monocot seeds, such as wheat, oat, grass, barley and corn. Plant a row of each and keep a record of what was planted in each row. In another cigarbox or seed flat do the same thing with fast-growing dicot seeds, such as radish, mustard, bean and pea.

When the first leaves appear, make sketches. In the early stages of growth all monocots are very similar to each other, and so are the dicots. Identification of the individual plant is difficult. This would seem to indicate the common ancestry of all monocots and the common ancestry of the dicots.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
C. Theories of evolution	Many explanations have been advanced to explain what may have caused living organisms to change through the years.
1. Use and disuse	Lamarck stated that organisms change as their needs change. If organs are needed, they develop; those that are not needed are reduced or lost. Lamarck's idea is not accepted today by most scientists, since it lacks supporting evidence.
2. Natural selection	Darwin said that nature selects the organisms that will survive in the following manner:
	. there is an overproduction of organisms
	. a struggle for existence among these organisms results.

MATERIALS

ACTIVITIES

Discuss again the meaning of a scientific theory. Any scientific theory must account for known facts and is subject to modification or discard as new facts and evidence are presented.

Acquired characteristics cannot be inherited. A skilled pianist or carpenter does not produce children which have the skills. These must be learned.

Report on Darwin's life - illustrate the growth of his ideas into the theory as evidence accumulated.

KEY WORDS

natural selection

Overproduction

Count or estimate the number of eggs in a mass of frog eggs, the seeds produced by a single maple tree in one season, or the number of seeds on a single dandelion head. From this count it is obvious that more individuals are produced than live to maturity. It is also obvious that if all did live to maturity, there would soon not be enough room on earth for its living things.

There may be places on the school grounds where pupils can observe hundreds of seedlings springing up under a single tree, or quantities of acorns or other seeds. Each is capable of reproducing its own kind, thereby littering the ground.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

. variations may exist among organisms

. those organisms with variations that best adapt them to their environment survive.

MATERIALS

small metric rulers
bean seeds

ACTIVITIES

The fact that measurable characteristics of organisms vary. and the normal distribution of that variation, can easily be demonstrated in class.

Provide each student with 50 beans of the same species, and a millimeter rule. After the lengths of the beans have been measured, a bar graph can be constructed to indicate how many individual beans there were of each length. There will be more individuals of the middle value than either extreme. All the individual graphs can then be combined into a master graph showing the results obtained by the entire class. This graph would be expected to show a larger range than the graph of any individual student.

A similar graph can be constructed utilizing the height, shoe size or pulse rates of members of the class. A similar type of distribution will be obtained.

Point out to pupils that, in studying variations in any given species, a large number of specimens is necessary. In order to gain an accurate concept of the species, students need to know its limits or variation. Our natural history museums contain thousands of specimens of a single species of insect, bird, mammal and others for scientists to study.

KEY WORDS

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

. those individuals that survive pass their favorable variations on to their young.

. a whole new species evolves with these favorable variations.

MATERIALS

ACTIVITIES

Dandelions and plantain survive droughts better than most grasses. The reasons for this can be shown.

Bring to class a block of sod cut from a weedy lawn. Be sure to include dandelion and plantain in the block.

Shake some of the dirt from around the roots of the plants. The roots of the dandelion and plantain will be seen to go deeper into the soil than those of the grass. This enables the weeds to continue to get moisture when the soil has become too dry to support the grass.

The leaves of the plantain and dandelion form rosettes, covering more area than the la leaves of the grass. They are thus able to carry on more photosynthesis than the grass, thereby growing faster.

Their leaves shade the underlying grass so much that the grass dies. Ask a student to lift up a few of the rosette leaves and report to the class what he sees under them. In addition to absence of competing grass, the student will often discover that the soil under the rosette is somewhat more moist than the surrounding soil.

Key Words

variations

REFERENCE OUTLINE

3. Modern theory of evolution

OBJECTIVES AND UNDERSTANDINGS

A modern theory of evolution states that species have changed through the years as the result of:

. natural selection

. mutations

. isolation

. environmental changes

MATERIALS

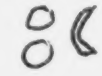
ACTIVITIES

In this area there is an opportunity to shed light on some social problems with presentation of scientific data, attitudes and theories. The teacher can aid in opening minds to new facts, ideas and thought patterns.

Use the Socratic method to present an organized discussion of the case of Sickle Cell anemia.

Review - a mutation on the gene for hemoglobin results in "sickled shaped" red blood cells which cannot carry oxygen.

The mutations H^S is non dominant to the gene for normal red blood cells H^n.

Genotype		Phenotype
H^nH^n		Normal red blood cells
H^SH^S		Red blood cells sickled (Lethal) - Sickle cell anemia
H^SH^n		Sickle cell "trait" A handicap in carrying oxygen but not lethal

1. The H^S gene is eliminated from populations by the death of sickle celled anemiacs.

Therefore, the frequency of this gene should decrease.

Problem: The number of individuals with the sickle cell trait is high and remains high in the population of equatorial Africa. How is this possible.

Allow students to propose hypotheses such as:

a. There is a high mutation rate.

b. H^nH^S (trait) produce more offspring than H^nH^n (normal).

c. H^SH^n may give an advantage.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

The success of a mutation depends upon the environment in which it occurs.

MATERIALS

ACTIVITIES

2. Point out - There is a high incidence of malaria in this area of Africa. Some students may recall that malaria affects the red blood cells.

3. Tests have shown that poeple with (H^SH^n) - sickle cell trait have a much smaller chance of contracting malaria than do people with normal red blood cells.

Conclusion: Sickle Cell anemia (H^SH^S) is lethal in any environment. Sickle cell trait is a handicap in terms of maximum oxygen intake in all environments. However, people with sickle cell trait have an advantage over those with normal red blood cells in areas where malaria is prevalent. This accounts for the persistently high frequency of the H^S gene in such populations.

Ask: What would you expect to be the frequency of the H^S gene in the black population of the United States?

Answer: It is greater than the frequency for the non black population but less than the frequency found in equatorial Africa.

Ask: Why might this be so?

Answer: Malaria is not common in the U.S., therefore, the sickle cell trait is of no advantage. The H^S gene is eliminated as a lethal and the gene frequency of this H^S factor continues to decrease.

REFERENCE OUTLINE

D. Man's evolution

OBJECTIVES AND UNDERSTANDINGS

The evolution of man is not completely understood principally because of the scarcity of fossils and other evidence.

There is no proof for the assumption that man evolved from the apes, though some assume that both came from a common ancestor.

Fossils have been found of the following prehistoric men:

. Zinjanthropus

. Australopithecus

. Java Man

. Neanderthal Man

. Cro-Magnon Man

MATERIALS

ACTIVITIES

Teacher Note: *Present some of the "speculations" about human evolution based upon the sketchy evidence we now have. Point out again the theoretical nature of much of this "story". We can, of course, never "know" the full story. This should be presented as some interesting ideas of some scientists rather than as fact to be memorized.

The undue concern over skin color is unfortunately still with us. As long as this is the case, students may as well be presented with some scientific reasoning as to a possible explanation of the distribution of melanin in human populations.

1. The earliest Hominidae may have been a vegetarian forest dwelling primate in central Africa over 2 million years ago.

2. Migration and/or climatic change (from forest to grassland) may have accelerated natural selection of new traits arising through mutations to meet adjusted environmental conditions.

*optional

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Some chacteristics that are unique to man are:

- superior brain that enables him to reason, speak, and use tools well
- an upright posture

MATERIALS ACTIVITIES

COMPARATIVE STUDY OF MAN THROUGH TIME

Change	Evidence	Possible Advantage
Diet From 1st order to 2nd order consumer	Dental structure of fossils	Necessary due to loss of easy access to forest vegetation--fruits, etc.
Posture More upright	Skeletal fossils	To see prey over tall grass.
Day time hunting	Poor night vision common to most primates.	Better chance to see prey.
Loss of body hair and increase in the number of sweat glands	Indirect comparison of "primative" primates with Homo sapiens	Cooler hunting in tropical sun
Increase of melanin in skin	Speculative Primates have little melanin in hair covered skin	Protection from the direct rays of the sun on exposed skin
Increase in brain size	Fossil cranial capacity measurements show increase from older to newer fossils.	Hominidae are not a physical "match" for most other animals but must rely on intelligence.
Social Evolution	Caves indicate multiple occupancy "burial grounds"	Group action for food-getting and protection

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

All present-day people are classified into one species because all peoples are so similar.

This one species of Homo sapiens may subdivided into three major stocks:

. Caucasian

. Negroid

. Mongoloid

MATERIALS ACTIVITIES

Change	Evidence	Possible Advantage
Greater physical differences between male and female	Fossil Remains Speculative Reasoning 1) Larger brain case required. Longer pregnancy and changes in female pelvic bones structure for birth. 2) Social evolution demanded a longer period of postnatal development.	Division of labor. The emphasis on learned behavior for survival may have brought greater parental care and longer adolescence.
Migration northward	Most anthropologists agree that man originated in Africa. From fossil evidence.	Less competition. An expanding population of hunters and gatherers required more territory. Territoriality probably existed. It is found in most animals especially social ones and predators.
Decrease in melanin in skin	Correlates with gradation of melanin in native populations from Africa to Mediterranean to Nordic peoples.	None In cooler climates of the northern latitudes (where clothing was used for warmth and there was less intense solar radiation) there would be no advantage of high melanin content. Random genetic drift could account for a gradual reduction in melanin.

Points: Only Albinos lack pigment.

The exposure to solar radiation causes an increase of melanin in the skin in people of all populations.

Some individuals even have melanin in "patches" or freckles.

REFERENCE OUTLINE OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

Most anthropologists account for the physical differences in human populations on the basis of random genetic drift due to a period of temporary geographic isolation after the original migrations. This isolation is now largely eliminated by modern transportation. We may expect differences to continue to decrease.

Classification of human subgroups cannot be on the basis of any single characteristic. "Caucasians" include some of the darkest skinned peoples (Caucasians of India). The so-called "Black race" included the smallest people, pygmies and the tallest watusies. Skin color variations within groups is often greater than between individuals of different groups.

There is only one species of man today. Considering his worldwide distribution, man has amazingly little sub-species differentiation, although much has been made of these relatively minor differences.

UNIT VII

ECOLOGY

UNIT VII - ECOLOGY

I. Ecology
   A. Physical factors
   B. Biological factors

II. Biotic Organization
   A. Population
      1. Growth rate
      2. General characteristics

   B. Community

   C. Ecosystem
      1. Interactions
      2. Specific relationships
         a. Parasitism
         b. Mutualism
         c. Commensalism
         d. Ecological habitat
      3. General relationships
         a. Energy flow
         b. Energy pyramid
         c. Cycles of matter
      4. Succession

   D. Aquatic Communities
      1. Marine
      2. Fresh water

III. Biosphere and Man
   A. Environmental Pollution
      1. Water
      2. Air
      3. Land
      4. Effects of pollution

   B. Conservation

REFERENCE OUTLINE

I. Ecology

OBJECTIVES AND UNDERSTANDINGS

To help students recognize that all living things live in relationship to both a biological and a physical environment.

To acquaint the students with some of the physical and biological factors which influence the survival of living things in a particular habitat.

To recognize that individuals are members of populations of similar organisms.

To make students aware of the need for conservation of natural resources.

Living things are influenced by other living things as well as non-living factors in the environment.

No organism exists as an entity separate and distinct from its environment.

Ecology is the study of the relationship of organisms with each other and with their environment

MATERIALS

ACTIVITIES

Key Words

ecology
environment
survival
conservation

REFERENCE OUTLINE

A. Physical Factors

OBJECTIVES AND UNDERSTANDINGS

The ability of an organism to live and reproduce is affected by various physical factors in the environment.

Some of these non living (or abiotic) factors include:

- air
- water
- light
- heat
- soil
- minerals

B. Biological or Living Factors

Man and other living organisms can not exist without affecting and being affected by other living things surrounding them.

MATERIALS

watch
meter stick
thermometers
bottles (screw top)
stiff cardboard
distilled water

ACTIVITIES

Comparative Study of Physical Factors- heat and moisture (relative humidity)

1. Let the students work in small groups consisting of three pairs.

2. One member of each pair reads the instruments; the other fans the thermometer and records the data.

3. Before starting, the three recorders set their watches and agree on a time at which each measurement is to be made.

4. These times should be recorded on a chart similar to the one below:

LOCATION	PLACE:			
	HEIGHT			
	0 cm.	30 cm.	90 cm.	150 cm.
TIME				
Dry - Bulb Temperature				
Wet - Bulb Temperature				
Relative Humidity				

Key Words

physical
biological

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

5. Measurements will be made to compare three types of environment or habitats.

   a. One pair of students will take measurements in a dense cover of vegetation. Preferable a woods, but a thicket or a mass of shrubbery around the school yard may be used.

   b. A second group will take measurements on a lawn.

   c. A third group will take measurements that has no vegetation - bare ground like a tennis court, a track, or parking lot.

6. The three habitats should be as close together as possible.

7. In each habitat, four sets of measurements are taken.

8. Readings on both types of the thermometers should be taken at the same time.

9. Thermometers should be in their positions at least 5 minutes before readings are taken.

*Note: The wet-bulb temperature is obtained by soaking the sleeve of a thermometer in water and fanning it vigorously for at least 2 minutes before making the reading. At least 8 minutes should be scheduled between readings. Shield the thermometers from the direct rays of the sun.

The reading from the dry-bulb thermometer is the air temperature. To find the relative humidity on the table, you need both dry-bulb and wet-bulb thermometer readings.

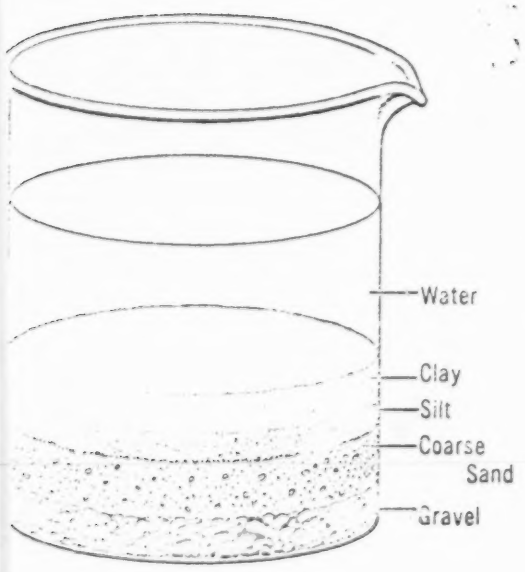
*A wet-bulb thermometer is made by tying a lamp wick around the bulb portion of the thermometer.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

thermometer
hammer
string
mortar and pestle
metric rule
pH paper
beakers
test tubes
stirring rod
small plastic bag
graduated cylinder



A Soil Profile

ACTIVITIES

Physical Factors of the Environment

1. Students may work in small groups.

2. Each group should select a test site near the school grounds to provide a variety of environmental conditions in the general area.

3. After selecting a test site for your group, obtain a soil sample (about 500 ml.). Place the collected soil in a small plastic bag.

4. Soil Texture -

a. Observe your test site and compare it with the other test sites of the class. Record your observations.

b. To determine the soil texture, remove about 125 milliliters of soil from the plastic bag and dry the sample in an oven. After the soil is completely dry, grind the soil thoroughly, using a mortar and pestle. Place the pulverized soil in a beaker and add 100 milliliters of water. Mix the soil and water thoroughly then allow the soil to settle for twenty-four hours. After the soil has settled, the different-sized particles will form a soil profile consisting of visible layers. The largest particles will be on the bottom and the smallest particles at the top. See the soil profile in the diagram at the left.

c. Determine the texture of each layer of soil. Textures might be identified as clay, silt, fine sand, coarse sand, or gravel. Record the names of the consecutive layers of soil by writing the name of each texture in Table 1.

d. Using a metric ruler, measure the depth of each layer of soil. In Table 1 record depth in millimeters opposite the layer of soil being measured.

e. To determine the percentage of soil represented by each layer, divide the depth of a layer of soil by the total depth of soil in the beaker. Record the percentages in the column of Table 1, opposite the appropriate layer of soil. Keep the soil profile in water for the following procedure.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

Record your observations about texture and water-holding capacity of the soil in the following tables:

TABLE 1. PROFILE OF SOIL SAMPLE

Layers of Soil	Depth of Layers in mm	Percentage of Total Soil
Total:		

5. Water-Holding Capacity

a. Using the wet soil in the beaker, determine the water-holding capacity of your soil sample. Carefully pour off the water in the beaker until the soil is saturated, but no water is standing above the soil. Save the water for an acidity test. Determine the weight of the beaker containing the wet soil (M_1) and record the data in the first column of Table 2.

b. Dry the soil thoroughly in a hot oven. After the soil is completely dry, determine the weight of the soil and the beaker (M_2) and record the data in the second column of Table 2.

c. Empty the soil from the beaker, then wash and dry the beaker carefully. Determine the weight of the clean, dry beaker (M_3) and record the data in the third column of Table 2.

d. Determine the weight of the saturated soil (M_4) by subtracting M_3 from M_1. Record the data in the fourth column of Table 2

e. Determine the weight of the water contained in the soil (M_5). To do this, subtract M_2 from M_1. Record the data in the fifth column of Table 2.

f. Determine the water-holding capacity of the soil. Express it as the percentage of water in a sample of saturated soil. To find the percentage, divide M_5 by M_4. Record the data in the last column of Table 2. Someone in the class should reproduce a table similar to Table 3 on the chalkboard to record the class data. Record the water-holding capactiy of your soil sample in the appropriate column of class data.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

MATERIALS

ACTIVITIES

TABLE 2. DATA CONCERNING WATER-HOLDING CAPACITY

Wt. of Beaker and Saturated Soil M_1	Wt. of Beaker and Dried Soil M_2	Wt. of Beaker M_3	Wt. of Saturated Soil $M_4 = (M_1 - M_3)$	Wt. of Water $M_5 = (M_1 - M_2)$	Water-Holding Capacity (%) $= M_5 \div M_4$

6. Soil Acidity

a. Obtain a strip of pH test paper and dip one end of it in the water saved from the study of the water-holding capacity. Remove the test paper and compare the color of the wet end with the colors in the chart on the test-paper dispenser.

b. After obtaining a color on the test-paper chart that resembles the color of the wet test paper, note the numeral accompanying the color on the chart. The numeral indicates the pH-that is, the acidity or alkalinity of your soil sample. Record the pH of your soil sample. Copy your pH numeral on the chalkboard in the appropriate column of the table.

VARIATIONS IN ACIDITY, AND WATER_HOLDING CAPACITY

Group	Water-Holding Capacity	pH of Soil
1		
2		
3		
4		
5		
6		

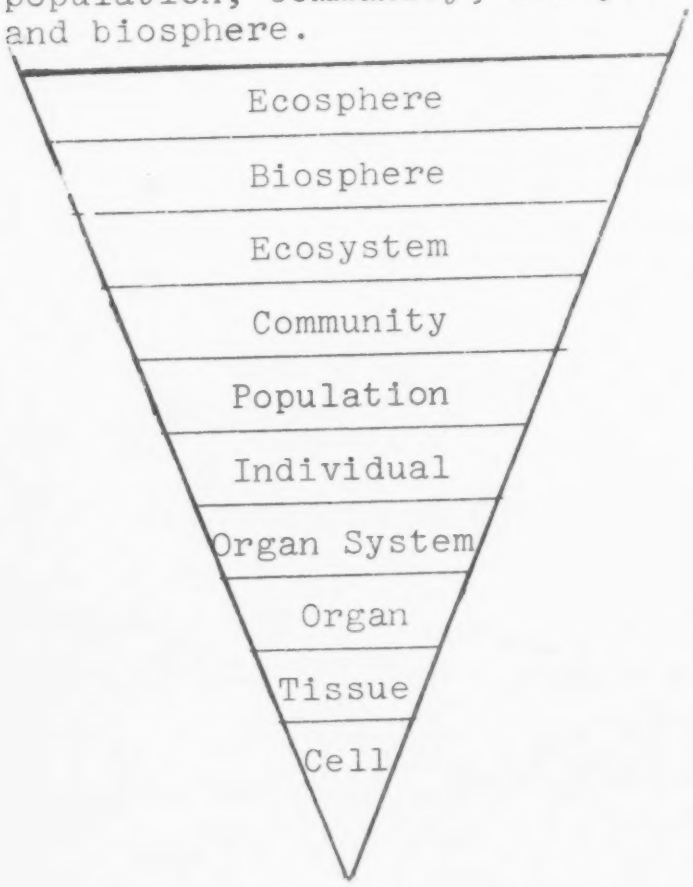
REFERENCE OUTLINE

II. Biotic Organization

OBJECTIVES AND UNDERSTANDINGS

No living thing lives alone. There are relationships which exist between various living things within our environment. An organism cannot exist without influencing and being influenced by other living organisms in its environment.

Teacher's Note: The hierarchy shown below is man's invention for the complex organization of nature. In this unit we shall discuss only population, community, ecosystem, and biosphere.



MATERIALS

ACTIVITIES

Discuss the similarities between the organization of nature and the organization in industry or government.

Key Words

biosphere

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
A. Population	A population is a group of individuals of a single species that is limited to a particular area. A species is a group of organisms that are more or less alike. Examples of population: The number of carp in a lake is the carp population; mice living in a city block make up the mouse population. The total number of cockroaches in a building, frogs in a pond, or lilacs in a park are each a population in their community.
1. Growth Rate	The growth rate of a population depends on two main factors: . the number of organisms added through reproduction . the number of organisms lost by death or migration.
2. Characteristics	The human population is growing at an unprecedented rate. It is increasing more rapidly than the food supply. Half of the world population does not have an adequate food supply.

MATERIALS

paramecium
water flea
didinium
brine shrimp
goldfish
planaria
earthworm
sowbug

ACTIVITIES

The interaction of individuals of a population with their environment.

Note: It is important to have an ample supply of healthy specimens.

1. The students will examine a series of living organisms and their reaction to one environmental factor, light.

2. Place populations of the eight different animals around the room.

3. The name of the organism is next to each of the populations.

4. Spend a few mminutes looking at an individual from each of these populations.

5. Observe carefully. Record data regarding the general appearance and behavior of the various specimens.

6. Prior to the tests for light responses, all animals must be dark-adapted for a period of several hours to a day.

7. Dark adaptation of the animals may be done by placing the animals in a darkened room or by covering the container holding the animals with a dark cloth or cardboard box.

Key Words

population

Note: Animals used for general observations need not be dark adapted.

8. Darken the laboratory as much as possible by turning off ceiling lights and closing the window shades. The darker the room, the better the results.

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

A population has certain characteristics such as:

- Birth rate
- Death rate
- Density - the number of organisms
- Dispersal - the tendency of organisms to spread out from a particular locality.

Each of these characteristics is subject to change as a result of changes in either its biological of physical environment.

MATERIALS

ACTIVITIES

You and your partners should work with an individual from as many of the different populations as time allows. Start with the animal that interests you most. Do not worry about testing all the populations if time runs out. Members of your class can share data with you.

Put the animal that has become adjusted to the dark in a dim, diffuse light and observe what it is doing. If the room is light enough so that you can see the animal, you will not have to use the dim light.

Then use a bright light that shines in one direction, such as a bright penlight. Shine it first from either side, and then from in front and above the animal. Record your observations in the table provided.

Animal	Direction of Light	Response
Paramecium	From side	
	From above and front	
Didinium	From side	
	From above and front	
Water flea	From side	
	From above and front	
Brine shrimp	From side	
	From above and front	
Goldfish	From side	
	From above and front	
Planaria	From side	
	From above and front	
Earthworm	From side	
	From above and front	
Sowbug	From side	
	From above and front	

Key Words

density
dispersal

Did all the animals respond in the same way? If not, what are some of the variations? What might be the advantage or disadvantage of each of the animals reacting as they did?

REFERENCE OUTLINE

B. Community

OBJECTIVES AND UNDERSTANDINGS

Plants and animals seldom live alone. A community consists of many populations of plants and animals living together in a given environment.

A biotic community is very complicated. It maybe small, as in a small pond in a park, or it may be a vast forest which extends for several miles.

The many populations in a community are constantly interacting with one another.

Every change in the biotic environment whether it involves water, temperature, or some disturbance - will favor some types of life and be detrimental to others.

Even in more or less stable communities, conditions never remain the same.

MATERIALS

ACTIVITIES

Populations interact with other populations to form a community.

If we were to study a community, what sorts of things might we want to discover about it?

- What populations are present?
- How do these populations interact with each other?
- What is the density of each population in the community?
- What environmental factors affect the populations of the community?
- How could we go about solving these questions?

Key Words

interaction
biotic community

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
C. Ecosystem	All of the living plants and animals in a community and the non-living things in the environment work together in a system (ecosystem). Neither the living organisms in a community nor the non-living parts of the environment can be fully understood when studied separately. The living and non-living parts of our environment form a single interacting system called an ecosystem.
1. Interactions	The interrelationships between the living and non-living factors in an environment may be shown by: . the flow of energy in a food web or food chain. . the cycles of matter

MATERIALS

two aquaria
goldfish
culture of brine shrimp

ACTIVITIES

Observing two populations within a community.

1.. Set up two equal aquaria side by side.

2. In one aquarium, place a population of goldfish.

3. Allow the goldfish time to become acclimated.

4. In the other aquarium, set up a population of brine shrimp. Allow these individuals time to become acclimated also.

5. Students should observe and record data on the two populations.

6. Record information on the distribution, number, behavior and so on.

7. Place an equal population of brine shrimp into the goldfish tank and an equivalent population of goldfish into the brine shrimp tank.

8. Students should observe the aquaria and record data.

   a. How did the original goldfish population react when a population of brine shrimp was added to its environment?

   b. How did the original brine shrimp population react when a population of goldfish was added to its environment?

9. By attaching a transparent number grid to the side of each aquarium, the students will have some landmarks with which to make quantitative observations.

Key Words

ecosystem
interrelationship

REFERENCE OUTLINE

2. Specific relationships

OBJECTIVES AND UNDERSTANDINGS

Living things are continuously interacting with each other and may affect each other in a variety of ways.

Perhaps eating and being eaten is the most important relationship between animals.

Based on their nutritional interactions, species maybe divided into two groups:

. Producers - all green plants

. Consumers - animals and microorganisms which eat other animals-and plants.

Decomposers - microorganisms which bring about the decay of dead plants and animals.

MATERIALS

ACTIVITIES

Microcommunities maybe set up in the classroom.

For example, a snail, water-plant, water and light.

Key Words

producer
consumer

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Living things may establish a variety of interrelationships based on their food getting patterns.

Many organisms must depend upon other organisms for food.

a. Saprophytes - organisms which live on dead material. Decomposers, such as bacteria of decay return vital materials to the soil.

b. Herbivores - plant-eating animals such as the rabbit, the horse, and the cow.

c. Carnivores - flesh-eating animals.

(1) Predators - animals which kill other living animals for food. Examples are lions and hawks.

(2) Scavengers - an animal who performs a cleanup task. They find dead animals to eat instead of capturing and killing their own. Vultures, termites, and earthworms are scavengers.

d. Omnivores - animals that eat both plants and other animals. For example, man, raccoon, and opossum.

MATERIALS

ACTIVITIES

Key Words

predators
scavengers

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
	Unlike living things may establish a rather close association with each other. This relationship may not always be beneficial to them.
a. Parasitism	The parasites benefit at the expense of the host. Such organisms as body lice, ticks, leeches, and the fungi which cause ringworm and athlete's foot are called parasites.
b. Mutualism	In a mutual arrangement, both organisms benefit. For example, man and some of his intestinal bacteria; the termite and the protist which live within the digestive tract of the termite.
c. Commensalism	Commensalism is a rather one-sided relationship in which one organism is benefited and the other organism is unaffected. For example, Spanish moss grows on trees; the remora attached to the shark gets a free ride as well as food left by the shark.
d. Ecological Habitat	Several factors affect where an organism lives (habitat). These factors include both living and non living things. Many plants and animals share the same habitat, but their "life style" is not the same. An organism's style or way of living in it's habitat is referred to as the organism's ecological niche. For example, a doctor and a lawyer may have offices in the same building, but what one does is very different from what the other does. They occupy different ecological niches.

MATERIALS

ACTIVITIES

Key Words

mutualism
commensalism
habitat
niche
parasite

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
3. General Relationships	
a. Energy flow	All living things require energy. Whatever the organism, there is some source from which the organism derives energy.
	Green plants serve as food for animals, fungi, and other organisms which cannot produce their own food.
	Green plants are called primary producers.
	All other organisms that are dependent upon green plants for food are called consumers.
	The transfer of energy from a green plant to a plant eater, with a loss of energy at each step is called a food chain.
	Since organisms eat so many different kinds of foods, it is better to speak of a food web than of a food chain.
b. Energy pyramid	Energy is lost at each step of the food chain.
	As we follow materials along a food chain, we observe losses of energy in the form of heat along the entire chain.
	Green plants capture only a small amount, probably only about 1% of the radiant energy that strikes the earth.
	From this small percentage, green plants must produce sufficient food to maintain themselves and to feed all of the other animals and non-green plants.

MATERIALS

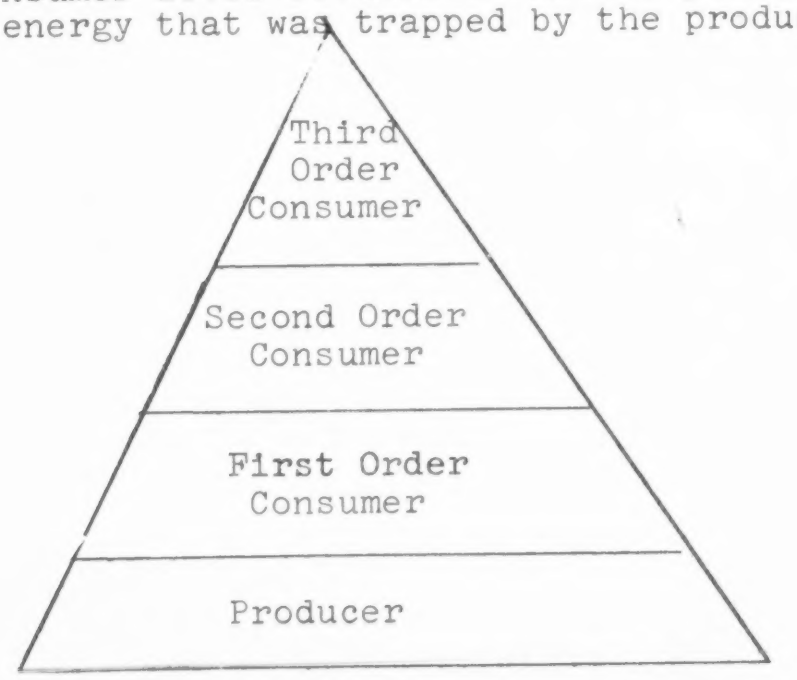
ACTIVITIES

A Simplified Energy Pyramid

All living organisms carry on activities that result in the release of energy.

The base of the pyramid represents energy stored as food in green plants, the producers.

Successive steps of the pyramid shows that each consumer level obtains a smaller percentage of the energy that was trapped by the producer.



Key Words

food chain

A diagram of an energy pyramid may be used to discuss and illustrate the loss of energy at the various steps of the food chain.

The base of the pyramid shows energy stored as food in green plants.

The energy pyramid should indicate why there is greater food resources available to man as a vegetarian than to man as a carnivore. It also indicates why herbivores are more numerous than carnivores.

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
c. Cycles of matter	Many cycles exist in the environment. They help to maintain a balance in nature. Without cycles vital substances would not be available to man and other living organisms. Examples of cycles are nitrogen, oxygen, carbon, and hydrogen. Decomposers, such as bacteria of decay, help to complete these cycles by returning matter to the soil.

MATERIALS

ACTIVITIES

Review the various cycles.

a) O_2 - CO_2 cycle

b) N_2 cycle

Key Words

cycle

REFERENCE OUTLINE

4. Succession

OBJECTIVES AND UNDERSTANDINGS

A community undergoes constant change. Slowly, but surely various factors create a new environment. With these changes, a community of different plants and animals replaces the old community.

Succession occurs when the balance in nature is upset.

The first organisms to populate a given location are called pioneer organisms. Lichens are pioneer organisms on bare rock.

The end result of a succession is called a climax community.

Climax communities are stable because energy-relationships between organisms of the community are balanced.

The process of succession is very slow, perhaps involving centuries.

MATERIALS

series of pictures or a film

ACTIVITIES

It is difficult to develop a feeling or understanding of succession, because it takes too long for the students to study these continuous changes from beginning to end.

1. Give the students a series of data in the form of pictures collected from the same location over a period of time. (Films or slides may also be used)

2. Discuss these pictures.

3. What has happened between the first and second pictures in each series? (All responses should include the idea of change.)

4. Can you suggest events that might result in succession? (Struggle for food, catastrophic occurrences, such as flood, wind, fire, etc.)

Do you think the communities pictured would be the same if you examined them in another season? (Here is an opportunity to suggest seasonal and cyclic changes.)

Would you expect succession in nature to go on indefinitely?

Succession may be summarized by showing the film "Succession--Sand Dune to Forest".

Key Words

succession
climax community
pioneer organism

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
D. Aquatic Communities	An aquatic community consists of plants and animals living in or near water. More than 70 percent of the earth's surface is covered by water. Ocean communities are referred to as marine communities. The greatest amount of food production in the world occurs in oceans. Fresh-water communities exist in and near ponds, lakes, rivers, and streams. Numerous environmental conditions such as ocean currents, salt water, depths of the sea, winds, storms, and changing temperatures, exert an influence on the plants and animals in an aquatic community.
III. Biosphere and Man	Man, as he has increased in technological knowledge, has brought about great changes in his environment. Man has succeeded in creating numerous biological problems. Man has resculptured the land, altered the courses of rivers, polluted the air and the water, eliminated various types of plants and animals. Man has also increased in numbers too rapidly.

MATERIALS

ACTIVITIES

Key Words

biosphere
aquatic

REFERENCE OUTLINE	OBJECTIVES AND UNDERSTANDINGS
A. Environmental Pollution	Pollution caused by man is a major threat to our natural environment. Pollution means the presence of harmful materials called pollutants, which maybe found on land, in the air and in the water. All pollution is bad.
1. Water Pollution	Water pollution is caused by: . raw sewage . chemicals such as mercury, DDT, and oil . detergents . infectious agents . heat pollution . radioactive substances . sediment
2. Air Pollution	The air of most large cities is polluted. Air pollution is caused by: . vehicle exhaust, which produces 95% of all carbon monoxide . sewage odors . smoke and gases from industrial wastes
3. Land Pollution	Land pollution is due to: . open dumps . power plants . junk cars . chemicals used in soil

MATERIALS

ACTIVITIES

A variety of approaches should be used to enable students to understand the seriousness and problems of environmental pollution, especially at the local level.

Reports
Discussion groups
Films
Filmstrips
Field trips

Pertinent to the Rochester area, pupils should report upon:

a) mercury pollution of Lake Ontario and the St. Lawrence River

b) Dying Lake Erie

c) Monroe County Pure Water Agency

d) Closing of the beaches and other recreational areas

e) Rat control

f) Smoke and smog control

g) The Genesee River

Key Words

pollution
pollutants

REFERENCE OUTLINE

4. Effects of Pollution

OBJECTIVES AND UNDERSTANDINGS

Some of the effects of water pollution are:

- spread of disease, such as cholera, dysentery, and hepatitis
- closing of recreational facilities
- destruction of industries, such as fishing
- upsetting the food web and balance which exists in nature

Some of the effects of air pollution are:

- spread of disease (contributes to respiratory infections)
- reduces crop yields
- increase in carbon dioxide content with resulting "greenhouse effect".

MATERIALS

ACTIVITIES

REFERENCE OUTLINE

OBJECTIVES AND UNDERSTANDINGS

Each individual should be aware of and concerned about the problems of our deteriorating environment.

Numerous causes of pollution have been identified and controls have been outlined.

Specific regulations on pollution control have been established and enforced by the government

Solutions to problems of pollution are:

- proper sewage treatment
- control of agricultural pollution
- control of industrial pollution
- control of waste from pleasure boats and commercial vessels
- control of automobile wastes

And effective control of environmental pollution can only be controlled though cooperative efforts between individuals, communities, industry and government.

B. Conservation

Once species and communities have been obliterated, they cannot be reconstituted by man in the immediate future.

Wildlife, forests, fertile soil, clean air and water are major natural resources important to man's welfare.

The aim of conservation is not to prevent changes from taking place, but rather to ensure that no plant or animal life existing in nature should become permanently lost as a result of man's recreational activities or technological know-how.

MATERIALS

ACTIVITIES

Discuss city and community planning as a form of conservation.

Obtain a copy of the State Game Laws and discuss the significance of the regulations with reference to wild life.

Key Words

conservation

APPENDIX

KEY WORDS

Unit I - Introduction

class
classification

death

kingdom

life
life activities
living organism

phylum

species

Unit II - Animal Physiology

adaptation
aerobic
aggression
amino acids
anaerobic
antibodies
associative

bacteria
behavior
biosphere

cancer
carbohydrates
cerebellum
cerebrum
conditioning
consumer

diffusion
digestion

egestion
endocrine
enzyme
excretion

fats
fear

glucose

homeostasis
hormones

immunity
inborn
infectious
ingestion
inoculate
instinct

learn

medulla
memory
metabolism
minerals

narcotic
neuron

pituitary
platelets
pollution
prejudice
preservative
producer
proteins
pulmonary

reason
reflex

sensory
social behavior
stimuli
symbiosis

thyroid
transport
tropism

virus
vitamins

Unit III - Plant Physiology

absorption
adaptation

cambium layer
characteristics
chlorophyll
chloroplast

diffusion

epidermis

function
fungus

glucose
guard cell

interrelationships

osmosis

petal
photosynthesis
pistil

respiration
root
root hairs

sepal
stamen
starch
stomates

transpiration

Unit IV - Reproduction and Development

Daughter cells

egg cell
embryo

fallopian tubes
fertilization
fission

gamete

menstruation
mitosis
mold

ovaries

placenta

regeneration

sperm
spontaneous generation
spores

testes

umbilical cord

zygote

Unit V - Genetics

albino

chance
characteristic
chromosome
cross
cytoplasm

dominant

fertilization

gamete
gene
generation
genetic code

heredity
homozygous
hybrid
hybridizing

inbreeding
inherited

mutation

nucleus

occurrence
offspring

probability

ratio
recessive
recombination

trait

vegetative propagation

zygote

Unit VI - The History of Life

embryo
evolution

fossil

natural selection

petrified

variations
vestigal

Unit VII - Ecology

aquatic

biosphere
biotic community

climax community
commensalism
conservation
consumer
cycle

density
dispersal

ecology
ecosphere
ecosystem
environment

food chain

habitat

interaction
interrelationships

mutualism

niche

parasite
pioneer organism
pollutant
pollution
population
predator
producer

scavenger
succession
survival